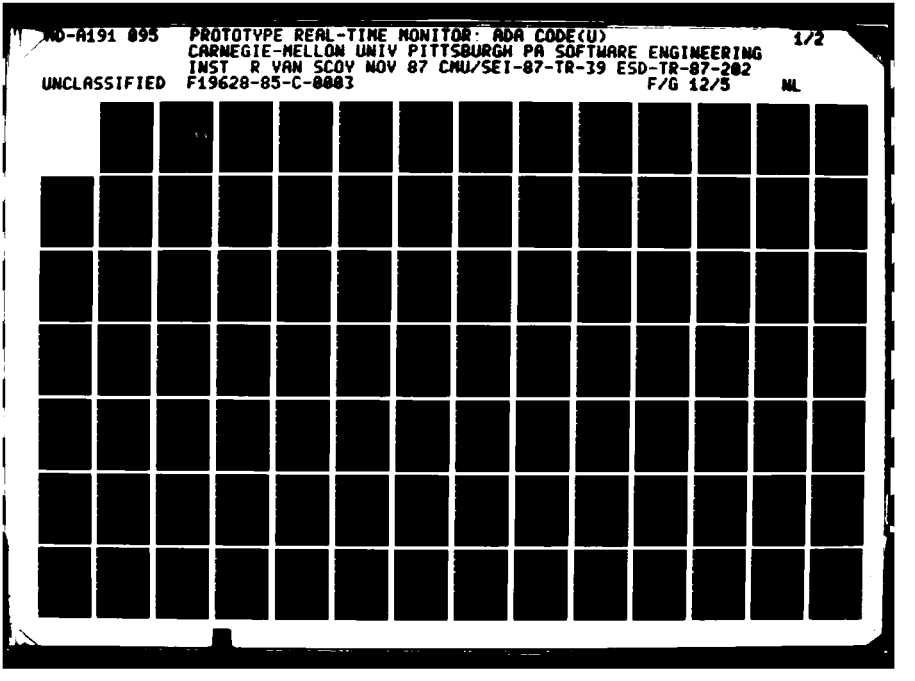
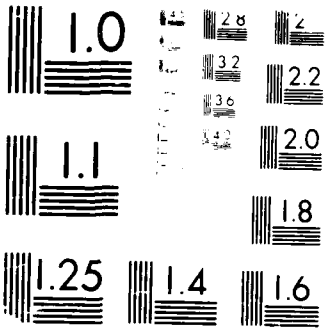

AD-A191 895 PROTOTYPE REAL-TIME MONITOR: ADA CODE(U) 1/2
CARNEGIE-MELLON UNIV PITTSBURGH PA SOFTWARE ENGINEERING
INST R VAN SCOY NOV 87 CMU/SEI-87-TR-39 ESD-TR-87-202
UNCLASSIFIED F19628-85-C-0003 F/G 12/5 NL



MICROCOPY RESOLUTION TEST CHART

Technical Report
CMU/SEI-87-TR-39
ESD-TR-87-202

(2)

Prototype Real-Time Monitor:

Ada Code

Roger Van Scoy

November 1987

Technical Report

CMU/SEI-87-TR-39
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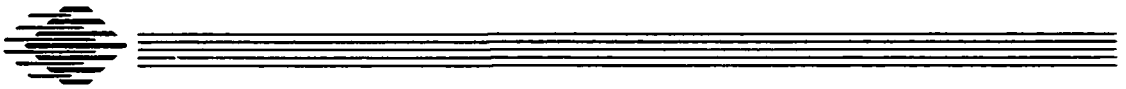
Prototype Real-Time Monitor: Ada Code



Roger Van Scoy

Dissemination of Ada Software Engineering Technology

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This technical report was prepared for the

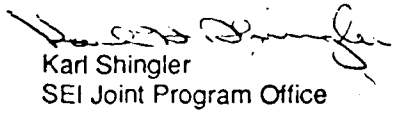
SEI Joint Program Office
ESD/XRS
Hanscom AFB, MA 01731

The ideas and findings in this report should not be construed as an official DoD position. It is published in the interest of scientific and technical information exchange.

Review and Approval

This report has been reviewed and is approved for publication.

FOR THE COMMANDER



Karl Shingler
SEI Joint Program Office

This work was sponsored by the U.S. Department of Defense.

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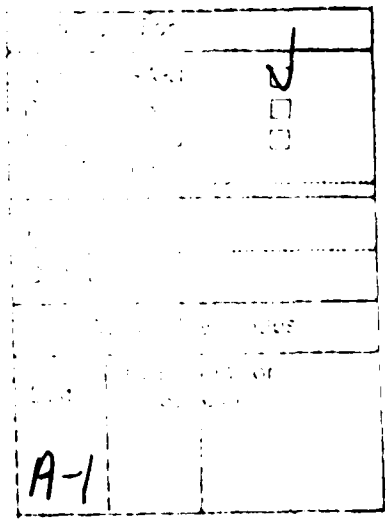

```
with Text_Io;use Text_Io;
with Test_Stub;
with Real_Time_Monitor;

procedure Appl is

begin
  loop
    Test_Stub.Go;
    begin
      Real_Time_Monitor.Rtm;
    exception
    when Real_Time_Monitor.Terminate_Rtm =>
      Put_Line("RTM terminated, application still running");
    end ;
  end loop ;
end Appl;
pragma page;
```

```
package Test_Stub is
   type  Rtm_Record is record
      I: Integer;
      R: Float;
   end  record ;
   type  Rtm_Pointer is access  Rtm_Record;

   type  Rtm_Enum is  (Hehe, Haha, Hoho);

   My_Array: array (1..5) of  Integer := (1,2,3,4,5);
   My_Pointer: Rtm_Pointer := new  Rtm_Record'(I => 2, R => 1000.0);
   My_Integer: Integer := 2;
   Int_2: Integer := 337;
   My_Real: Float := 10.0;
   My_Enum: Rtm_Enum := Hehe;

   procedure  Go;

end  Test_Stub;


package Test_Stub is
   procedure  Go is
   begin
      My_Pointer.I := My_Pointer.I + 2;
      My_Real := My_Real + 1.0;
      My_Integer := My_Integer + 1;

   end  Go;
end  Test_Stub;
pragma  page;
```

```
--|*****************************************************************
--| Module Name:
--|    Real_Time_Monitor
--|
--| Module Type:
--|    Package Specification
--|
--| Module Purpose:
--|    This package is the main driver for the RTM.
--|-----------------------------------------------------------------
--| Module Description:
--|  Implements the real-time monitor abstraction, i.e., all the
--|  commands found in the RTM User's Manual.
--|
--| References:
--|    Design Documents:
--|      Real-Time Monitor Requirements
--|        Real-Time Monitor Design
--|
--|    User's Manual:
--|        RTM User's Manual
--|
--|    Testing and Validation:
--|        none
--|
--| Notes:
--|    none
--|-----------------------------------------------------------------
--| Modification History:
--|  15Apr87    rlvs    Created
--|
--|-----------------------------------------------------------------
--| Distribution and Copyright Notice:
--|    TBD
--|
--| Disclaimer:
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--|     of Carnegie Mellon University, the U.S. Air Force,
--|     the Department of Defense, or the U.S. Government."
--|*****************************************************************

pragma page;
```

```
package Real_Time_Monitor is
--
-- Signals to the controlling program the termination of the real-time
-- monitor.
--
   Terminate_Rtm: exception ;

   procedure Rtm;
--/*****************************************************************
--| Description:
--|    This module is the RTM proper.  See the documents associated
--|  with the RTM for a complete descnption of what it does.
--|
--| Parameter Description:
--|  none
--/*****************************************************************

end Real_Time_Monitor;
pragma page;
```

```
--|*****************************************************************
--| Module Name:
--|    Real_Time_Monitor
--|
--| Module Type:
--|    Package Body
--|
--|-----------------------------------------------------------------
--| Module Description:
--|  This package just ties together the services needed to execute
--|  the RTM:
--|      the initialization procedure
--|      the command processor procedure
--|      the termination procedure
--|      and the RTM itself
--|
--| References:
--|    Design Documents:
--|      Real-Time Monitor Requirements
--|        Real-Time Monitor Design
--|
--|    User's Manual:
--|        RTM User's Manual
--|
--|    Testing and Validation:
--|        none
--|
--| Notes:
--|    none
--|-----------------------------------------------------------------
--| Modification History:
--|  15Apr87    rlvs    Created
--|
--|-----------------------------------------------------------------
--| Distribution and Copyright Notice:
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--|
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--|    representing official policies, either expressed or implied,
--|    of Carnegie Mellon University, the U.S. Air Force,
--|    the Department of Defense, or the U.S. Government."
--|*****************************************************************
pragma page;
```

```
with Rtm_Form; use Rtm_Form;
-- Use all the services.
--
with Define_Rtm_Cli; use Define_Rtm_Cli;
-- Use the type "rtm_command_representation".
-- Use all the services.
--
with Terminal_Interface;
-- Use the "open" and "close" services.
--

package Real_Time_Monitor is
--
-- Define the structures needed by the RTM to interface to the user.
--
   User_Command_Line: String (1..80);
   User_Command_Length: Natural;
   User_Line_Ready: Boolean := False;
   Command_Found: Rtm_Command_Representation;
--
-- Internal Procedures
--
   procedure Setup_Rtm is separate ;
   procedure Closeout_Rtm is separate ;
   procedure Process_The_Command (Users_Command : in Rtm_Command_Representation)
        is separate ;
--
-- Visible Procedures
--
   procedure Rtm is separate ;

--/**********************************************************************
--/
--/ Real-Time Monitor Body
--/
--/  Perform RTM initialization...
--/
--/**********************************************************************

begin
   Setup_Rtm;
end Real_Time_Monitor;
pragma page;
```

```
with Standard_Interface;
-- Use the execeptions "abort_process", "undefined_name", "no_default",
-- "abort_command" and "no_command".
--
separate (Real_Time_Monitor)
procedure Rtm is
--|*********************************************************************
--| Description:
--|   A complete description of the RTM and its functioning can
--|  be found in the documents referenced in the spec.  Here we
--|  will just describe how the RTM implements those functions
--|  at the highest level.  The RTM is organized as a cyclic executive:
--|     1. It polls the user for input.
--|     2. If the input is ready,
--|        a. parse the command
--|        b. execute the command (which happens only if a legal
--|           command was found).
--|     3. Update any active pages.  This happens every cycle through
--|        the RTM, regardless of whether the user types a command
--|        (legal or otherwise).
--|
--| Parameter Description:
--|   none
--|
--| Notes:
--|   none
--|*********************************************************************
begin
    begin
--
-- Attempt to get the user's command.
--
       Get_Rtm_Field (Field => Rtm_Command,
                      Field_Value => User_Command_Line,
                      Data_Available => User_Line_Ready);
--
-- When a command has been found,
--   - Parse the command
--   - Process the command
--   - Reset the parser for the next command line
--
       If User_Line_Ready then
          Command_Found := Rtm_Cli.Parse_Command_Line
            (Rtm_Commands,User_Command_Line);
          Process_The_Command (Users_Command => Command_Found);
          Clear_Command_Line (Command_Found);
       end if ;
    exception
--
-- The parser has a large number of exceptions that signal a bad
-- command; all of them are handled here, and relayed to the user.
--
       when Standard_Interface.Abort_Process |
          Standard_Interface.Undefined_Name |
          Standard_Interface.No_Default |
```

```
            Standard_Interface.Abort_Command =>
              Put_Rtm_Field (Field => Message_Field_A,
                        Field_Value => User_Command_Line);
              Put_Rtm_Field  (Field => Message_Field_B,
                        Field_Value => "Bad commad line, reenter");
          when Standard_Interface.No_Command =>
            null ;
          when Terminate_Rtm =>
            RAISE ;
          when others =>
            Put_Rtm_Field (Field => Message_Field_B,
                      Field_Value => "Bad Command line ");
        end ;
--
-- Finally, after the user command has been processed, we
-- perform our periodic update of any active pages
--
        Process_The_Command (Users_Command => Update_Active_Pages);
        Clear_Rtm_Field;
end Rtm;
pragma page;
```

```
separate (Real_Time_Monitor)
   procedure Setup_Rtm is
--/*****************************************************************
--| Description:
--|    This module is responsible for performing all initialization
--|    required by the RTM prior to execution.  It must:
--|      1. Open a terminal channel for I/O.
--|      2. Create the RTM forms.
--|
--| Parameter Description:
--|    none
--|
--| Notes:
--|    none
--/*****************************************************************
   begin
      Terminal_Interface.Open;
      Initialize_Rtm_Form;
   end Setup_Rtm;
pragma page;
```

```
separate (Real_Time_Monitor)
   procedure Closeout_Rtm is
--/*****************************************************************
--/ Description:
--/    This module performs all termination operations needed after
--/    completion of the RTM.  It must:
--/      Close the terminal I/O channel.
--/
--/ Parameter Description:
--/    none
--/
--/ Notes:
--/    none
--/*****************************************************************
   begin
      Terminal_Interface.Close;
   end Closeout_Rtm;
pragma page;
```

```
with Interact;
-- Use the service "interact".
--
with Terminal_Interface;
-- Use the service "clear_screen".
--
with Page_Processor;
-- Use the services "start_page", "stop_page", "check_page" and
-- "update_pages".
--
with Parameter_Manager;
-- Use the serivces "read" and "set".
--
separate (Real_Time_Monitor)
procedure Process_The_Command   (Users_Command: in Rtm_Command_Representation)
   is
--/*****************************************************************
--| Description:
--|   This command invokes the modules which implement the various
--|  commands.
--|
--| Parameter Description:
--|  users_command  -> The command identifier for the most recently,
--|                    successfully parsed user command.
--|
--| Notes:
--|   The Quit(); command is implemented in this module by raising
--|  the Terminate_Rtm exception, which is propagated out.
--|*****************************************************************

begin

   case Users_Command is
      when Edit =>
         Interact;
         Terminal_Interface.Clear_Screen;
      when Quit =>
         RAISE Terminate_Rtm;
      when Read =>
         Parameter_Manager.Read;
      when Set =>
         Parameter_Manager.Set;
      when Check =>
         Page_Processor.Check_Page;
      when Start =>
         Page_Processor.Start_Page;
      when Stop =>
         Page_Processor.Stop_Page;
      when Update_Active_Pages =>
         Page_Processor.Update_Pages;
      when others =>
         null ;
   end case ;

   exception
```

```
      when Terminate_Rtm =>
        Closeout_Rtm;
        RAISE ;
      when others =>
        null ;

    end Process_The_Command;
  pragma page;
```

```
--|*****************************************************************
--| Module Name:
--|    RTM_Form
--|
--| Module Type:
--|    Package Specification
--|
--| Module Purpose:
--|    This package abstracts away the details of using the
--|  forms management system for input and error messages.
--|-----------------------------------------------------------------
--| Module Description:
--|    This package hides from the RTM itself the actual details
--|  of dealing with the forms manager for I/O.  The
--|  services provided include:
--|
--|      1. Initilizing the message and prompt forms.
--|      2. Presenting error messages to the user.
--|      3. Setting up and retrieving data entered by the user
--|         into the prompt form.
--|
--| References:
--|    Design Documents:
--|       none
--|
--|    User's Manual:
--|       none
--|
--|    Testing and Validation:
--|       none
--|
--| Notes:
--|    none
--|-----------------------------------------------------------------
--| Modification History:
--|  16Apr87    rlvs    created
--|
--|-----------------------------------------------------------------
--| Distribution and Copyright Notice:
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--| Disclaimer:
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--|     of Carnegie Mellon University, the U.S. Air Force,
--|     the Department of Defense, or the U.S. Government."
--|*****************************************************************
pragma page;
```

```
package Rtm_Form is

--
-- This type defines the different interface modes used to communicate
-- with the user.  See package body for a complete description.
--
   type  Input_Mode is  (Screen_Mode, Command_Mode);

--
-- This type defines the different fields available to the RTM on the
-- RTM interface form.
--    message_field_a -> is an output-only message field.
--    message_field_b -> is an output-only message field.
--    rtm_command -> is an input-only field used only for obtaining
--          user inputs.
--    form -> is not a message field, but affects the rtm interface
--      form as a whole.  This is a shorthand notation for
--      performing the same operation on all the message fields.
--
   type  Rtm_Form_Fields is  (Message_Field_A, Message_Field_B,
                  Rtm_Command, Form);


   procedure  Initialize_Rtm_Form;
--/*****************************************************************
--| Description:
--|    Creates the RTM interface form and makes it available for use.
--|
--| Parameter Description:
--|  none
--/*****************************************************************

   procedure  Get_Rtm_Field (Field: In  Rtm_Form_Fields;
                  Field_Value: In out  String;
                  Data_Available: In out  Boolean);
--/*****************************************************************
--| Description:
--|    Displays the RTM prompt and retneves data entered by the
--|  user in the form.
--|
--| Parameter Description:
--|  field   ->  The name of the field on the RTM interface form from
--|          which to retrieve the data.
--|  field_value ->  The data entered by the user into the field.
--|  data_available  ->  A logical flag which indicates when data are
--|                available in the indicated field.  Important
--|                when asynchronous I/O is being used to interface
--|                to the user's terminal.
--/*****************************************************************

   procedure  Put_Rtm_Field (Field: In  Rtm_Form_Fields;
                  Field_Value: In  String := "");
--/*****************************************************************
--| Description:
--|    Modifies the value of a field on the RTM interface form.
```

```
--|  It then presents the information to the user.
--|
--| Parameter Description:
--|  field  -> The name of the field on the RTM interface form
--|            in which to store the data.
--|  field_value -> The data to be stored in the field.
--|*********************************************************************

   procedure Clear_Rtm_Field (Field: in Rtm_Form_Fields := Form);
--|*********************************************************************
--| Description:
--|    Blanks out the current value of a field on the RTM interface
--|  form.
--|
--| Parameter Description:
--|  field  -> The name of the field on the RTM interface form
--|            to blank.
--|*********************************************************************

   procedure Set_Input_Mode (Next_Mode: in Input_Mode := Command_Mode);
--|*********************************************************************
--| Description:
--|    Select the next input mode for the RTM interface form.
--|
--| Parameter Description:
--|  Next_mode  -> Needed interface mode to the user.
--|*********************************************************************

end Rtm_Form;
pragma page;
```

```
--|**************************************************************
--| Module Name:
--|    RTM_Form
--|
--| Module Type:
--|    Package Body
--|
--|--------------------------------------------------------------
--| Module Description:
--|    This package implements the RTM interface form.  This form is
--|  is visible to the rest of the RTM as four fields available for
--|  I/O - in reality, it is implemented as two separate forms.  The
--|  fields available to RTM are:
--|     Message_field_a: an 80 character output only field
--|                belonging to rtm_message_form.
--|     Message_field_b: an 80 character output only field
--|                belonging to rtm_message_form.
--|     Rtm_command:    a 70 character input only field
--|                belonging to the rtm_prompt_form.
--|     Form:           operates on all the fields above.
--|
--|
--|  The input_mode is used to select either:
--|     screen_mode: a semi-asynchronous input, that is,
--|               when the screen is being updated rapidly, and
--|               the RTM shouln't wait for input from the user,
--|               an asynchronous input is requested, and the
--|               RTM continues processing.  When the user strikes
--|               any key, the rtm_prompt_form is displayed and
--|               the user enters data synchronously.
--|     command_mode: a simple synchronous input using the
--|                rtm_prompt_form.
--|
--| References:
--|    Design Documents:
--|       none
--|
--|    Testing and Validation:
--|       none
--|
--| Notes:
--|    This package makes use of SYSDEP, which contains all VAX/VMS
--|  dependent features used by the RTM.
--|--------------------------------------------------------------
--| Modification History:
--|  16Apr87    rlvs    created
--|
--|--------------------------------------------------------------
--| Distribution and Copyright Notice:
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```

```
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--|    the Department of Defense, or the U.S. Government."
--|*****************************************************************
pragma page;
```

```
with Sysdep;
-- Use the service that allows for asynchronous input of a character
-- from the terminal.
--
with Form_Manager;
-- Use services needed to create a form.
--
with Form_Executor;
-- Use the services needed to manipulate the forms of the user interface:
--    present_form     -> to display a form to the user
--    modify_field     -> to replace the value in a field of a form
--    query_field      -> to retrieve the value in a field of a form
--


package Rtm_Form is

--
-- The current input mode from the user, as described above.
--
   Current_Input_Mode: Input_Mode := Command_Mode;

--
-- The form identifiers needed to access and manipulate the
-- forms of the user interface.
--
   Rtm_Message_Form: Form_Manager.Form_Access;
   Rtm_Prompt_Form:  Form_Manager.Form_Access;

pragma page;
```

```
   procedure Initialize_Rtm_Form is
--|*****************************************************************
--| Description:
--|    Creates the RTM interface forms and makes them available for use
--|  internally.  It does this by creating two forms and then
--|  defining their fields (one at a time).  We do the creation here
--|  to avoid any disk dependencies and the chance that the user
--|  would modify the forms.
--|
--| Parameter Description:
--|    none
--|
--| Notes:
--|    none
--|*****************************************************************
   Field : Form_Manager.Field_Access;
begin
--
-- Create the output-only message form.
--
      Form_Manager.Create_Form
        ((2, 80), (21, 1), Form_Manager.No_Clear, Rtm_Message_Form);
      Form_Manager.Add_Field
        (Rtm_Message_Form, "message-a", (1, 1), 80, Init_Value => "",
         Mode => Form_Manager.Output_Only, Field => Field);
      Form_Manager.Add_Field
        (Rtm_Message_Form, "message-b", (2, 1), 80, Init_Value => "",
         Mode => Form_Manager.Output_Only, Field => Field);
--
-- Create the input-only prompt form.
--
      Form_Manager.Create_Form
        ((2, 80), (23, 1), Form_Manager.No_Clear, Rtm_Prompt_Form);
      Form_Manager.Add_Field
        (Rtm_Prompt_Form, "", (2, 1), 5, Init_Value => "rtm> ",
         Mode => Form_Manager.Constant_Text, Field => Field);
      Form_Manager.Add_Field
        (Rtm_Prompt_Form, "rtm_command", (2, 6), 70, Init_Value => "",
         Mode => Form_Manager.Input_Output, Field => Field);
   exception
     when others =>
       null ;
   end Initialize_Rtm_Form;

pragma page;
```

```
   procedure Get_Rtm_Field (Field: in Rtm_Form_Fields;
                            Field_Value: in out String;
                            Data_Available: in out Boolean) is
--|*****************************************************************
--| Description:
--|   Displays the RTM prompt and retrieves data entered in the form
--|   by the user.  If input is requested from one of the output
--|  only fields or from the form as a whole, the data_available
--|  flag is returned as false (since no data can ever be obtained
--|  from these fields).  When input is requested from the rtm_prompt
--|  field, where all the user input comes from, two situations exist:
--|     in Screen_mode: we check the terminal to see if a character
--|                     has been typed.
--|           if not, data_available is returned as false.
--|           if so, then we place the rtm_prompt_form on the
--|                terminal and prompt the user.
--|     in Command_mode: we place the rtm_prompt_form on the
--|                terminal and prompt the user.
--|
--| Parameter Description:
--|   field  -> The name of the field on the RTM interface form from
--|             which to retrieve the data.
--|   field_value -> The data entered by the user into the field.
--|   data_available  -> A logical flag which indicates when data are
--|                      available in the indicated field.  Important
--|                      when asynchronous I/O is being used to interface
--|                      to the user's terminal.
--|
--| Notes:
--|   none
--|*****************************************************************
   begin
      case Field is
         when Message_Field_A =>
            Data_Available := False;
         when Message_Field_B =>
            Data_Available := False;
         when Rtm_Command =>
            case Current_Input_Mode is
               when Screen_Mode =>
                  Sysdep.Get(Data_Available);
                  if Data_Available then
                     Form_Executor.Present_Form(Rtm_Prompt_Form);
                     Form_Executor.Query_Field(Form => Rtm_Prompt_Form,
                                               Field => "rtm_command",
                                               Value => Field_Value);
                  end if;
               when Command_Mode =>
                  Form_Executor.Present_Form(Rtm_Prompt_Form);
                  Form_Executor.Query_Field(Form => Rtm_Prompt_Form,
                                            Field => "rtm_command",
                                            Value => Field_Value);
                  Data_Available := True;
            end case;
         when Form =>
```

```
            Data_Available := False;
        end case;
    exception
        when others =>
            null;
    end Get_Rtm_Field;

pragma page;
```

```
   procedure Put_Rtm_Field (Field: In Rtm_Form_Fields;
                            Field_Value: In String := "") Is
--|*****************************************************************
--| Description:
--|    Modifies the value of a field on the RTM interface form.
--|    It then presents the information to the user.  Since
--|  the rtm_command is input only, it is implemented as a nop.
--|  Likewise for the form option.
--|
--| Parameter Description:
--|    field   -> The name of the field on the RTM interface form
--|               in which to store the data.
--|    field_value -> The data to be stored in the field.
--|
--| Notes:
--|    none
--|*****************************************************************
   begin
      case Field is
         when Message_Field_A =>
            Form_Executor.Modify_Field (Form  => Rtm_Message_Form,
                                        Field => "message-a",
                                        Value => Field_Value);
            Form_Executor.Present_Form (Form => Rtm_Message_Form);
         when Message_Field_B =>
            Form_Executor.Modify_Field (Form  => Rtm_Message_Form,
                                        Field => "message-b",
                                        Value => Field_Value);
            Form_Executor.Present_Form (Form => Rtm_Message_Form);
         when Rtm_Command =>
            null ;
         when Form =>
            null ;
      end case ;
   exception
      when others =>
         null ;
   end Put_Rtm_Field;

pragma page;
```

```
   procedure Clear_Rtm_Field (Field: in Rtm_Form_Fields := Form) is
--|*********************************************************************
--| Description:
--|    Blanks out the current value of a field on the RTM interface
--|    form.
--|
--| Parameter Description:
--|    field  -> The name of the field on the RTM interface form
--|              to blank.
--|
--| Notes:
--|    none
--|*********************************************************************
      Blank_Line: String(1..80) := (1..80 => ' ');
   begin
      case Field is
         when Message_Field_A =>
            Form_Executor.Modify_Field (Form  => Rtm_Message_Form,
                                        Field => "message-a",
                                        Value => Blank_Line);
         when Message_Field_B =>
            Form_Executor.Modify_Field (Form  => Rtm_Message_Form,
                                        Field => "message-b",
                                        Value => Blank_Line);
         when Rtm_Command =>
            Form_Executor.Modify_Field (Form  => Rtm_Prompt_Form,
                                        Field => "rtm_command",
                                        Value => Blank_Line);
         when Form =>
            Clear_Rtm_Field (Message_Field_A);
            Clear_Rtm_Field (Message_Field_B);
            Clear_Rtm_Field (Rtm_Command);
      end case ;
   exception
      when others =>
         null ;
   end Clear_Rtm_Field;

pragma page;
```

```
   procedure Set_Input_Mode (Next_Mode: in Input_Mode := Command_Mode) is
--|*********************************************************************
--| Description:
--|    Select the next input mode for the RTM interface form.  This
--|  interface allows the user to modify the package parameter which
--|  toggles the interface between synchronous and asynchronous I/O.
--|
--| Parameter Description:
--|    Next_mode   -> Needed interface mode to the user.
--|
--| Notes:
--|    none
--|*********************************************************************
   begin
      Current_Input_Mode := Next_Mode;
   end Set_Input_Mode;

end Rtm_Form;
pragma page;
```

```
--/*****************************************************************
--| Module Name:
--|   Define_RTM_CLI
--|
--| Module Type:
--|   Package Specification
--|
--| Module Purpose:
--|   This package provides the interface to the command line
--|  interpreter of the RTM.
--|-----------------------------------------------------------------
--| Module Description:
--|   The interface to the command line interpreter (CLI) is composed
--|  of three parts:
--|     1. An enumeration type which names all the current commands
--|        available.
--|     2. An instantiation of a generic parser package.
--|     3. A general-purpose subroutine to get arguments from
--|        the user's command line.
--|  Basically, the CLI is set up to operate as follows:
--|     1. RTM main procedure:
--|        a. reads the user's command line
--|        b. parses the line for syntactic correctness
--|           using the rtm_cli defined below
--|     2. Each routine that implements a command is
--|        responsible for:
--|        a. fetching all the arguments for the command
--|        b. checking the arguments for sematic correctness.
--|
--|  The legal RTM commands and their arguments (defined in the
--|  body) are:
--|
--|     Check (page => <page name>);
--|     Edit ();
--|     Quit ();
--|     Read (name => <name>);
--|     Set (name => <name>, value => <value>);
--|     Start (page => <page name>, update_rate => <rate in secs>);
--|     Stop (page => <page name>);
--|
--|  Details about how the commands are used and what they do are
--|  discussed in the RTM User's Manual.
--|
--| References:
--|    Design Documents:
--|      Real-Time Monitor Requirements
--|        Real-Time Monitor Design
--|
--|    User's Manual:
--|       RTM User's Manual
--|
--|    Testing and Validation:
--|       none
--|
--| Notes:
```

```
--|  The command update_active_pages is used internally by the
--|  RTM and does not (and never should) have a definition in the
--|  body such that the user can invoke the command.
--|-------------------------------------------------------------
--| Modification History:
--|  16Apr87    rlvs    created
--|
--|-------------------------------------------------------------
--| Distribution and Copyright Notice:
--|    TBD
--|
--| Disclaimer:
--|    "This work was sponsored by the Department of Defense.
--|     The  views  and conclusions contained in this document are
--|     solely those of the author(s) and should not  be  interpreted  as
--|     representing official policies,  either  expressed or implied,
--|     of Carnegie Mellon University, the U.S. Air Force,
--|     the Department of Defense, or the U.S. Government."
--|*************************************************************
pragma page;
```

```
with Standard_Interface;
-- Use the generic package "command_line" to instantiate the parser for
-- the RTM command language.
--

package Define_Rtm_Cli is
--
-- Define the commands recognized by the RTM.
--
   type Rtm_Command_Representation is
      (Check,Edit,Quit,Read,Set,Start,Stop,Update_Active_Pages);
--
-- Create the CLI to parse the commands defined above.
--

package Rtm_Cli is new Standard_Interface.Command_Line
                    (Rtm_Command_Representation);
--
-- Create the structure to hold the argument definitions for
-- all the commands.  Use the "define_argument" entry.
--
   Rtm_Commands: Rtm_Cli.Process_Handle_Array;

pragma page;
```

```
   procedure Get_Argument (Command: in Rtm_Command_Representation;
                           Argument_Name: in String;
                           Argument_Value: in out String);
--/*****************************************************************
--| Description:
--|   Retneve an argument from a command line entered by the
--| user.  If the user defaults an argument, then the default
--| value is returned.
--|
--| Parameter Description:
--|  command -> The command which the user entered and is currently
--|         being processed.
--|  argument_name  -> The name of the argument that is needed
--|                in the command line.
--|  argument_value  -> The value entered by the user or the default
--|                value for the argument.
--|*****************************************************************

   procedure Clear_Command_Line (Command: in Rtm_Command_Representation);
--/*****************************************************************
--| Description:
--|   Used to reset the parser after a command had been parsed and
--| processed.
--|
--| Parameter Description:
--|  Command -> The name of the command which was just parsed and
--|          needs to be reset.
--|*****************************************************************

end Define_Rtm_Cli;
pragma page;
```

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```
with Standard_Interface;
-- Use the "set_tool" and "define_process" services.


package Define_Rtm_Cli is
--
-- Instantiate the package needed to define the arguments to the commands.
-- Use the Define_Argument entry in package String_Arguments.
--

package Sa is new Standard_Interface.String_Argument("string");

package Si renames Standard_Interface;
--
-- Visible Procedures
--
   procedure Get_Argument (Command: in Rtm_Command_Representation;
                           Argument_Name: in String;
                           Argument_Value: in out String) is separate ;

   procedure Clear_Command_Line (Command: in Rtm_Command_Representation)
     is separate ;

pragma page;
```

```
--|*****************************************************************
--|     Define_rtm_cli package body
--|
--| Description:
--|  What follows is the definition of all the commands and
--|  their arguments.  This is done in two steps:
--|     1. Define a process for the command.
--|     2. Define each of the  arguments for the command.
--|  This process is repeated for every user command in the RTM.
--|  The commands are defined in alphabetical order for ease
--|  of maintenance.
--|
--|*****************************************************************
begin
--
-- Identify the tool being created to the parser package, this isn't
-- used anywhere, but is required by the parser package
--
   Si.Set_Tool_Identifier ("RTM");
--
-- Define the check command --
--
   Si.Define_Process (Name => Rtm_Command_Representation'Image(Check),
                      Help => "See RTM User's Manual",
                      Proc => Rtm_Commands(Check));

   Sa.Define_Argument(Proc => Rtm_Commands(Check),
                      Name    => "page",
                      Default => "",
                      Help    => "See User's Manual");
--
-- Define the edit command --
--
   Si.Define_Process (Name => Rtm_Command_Representation'Image(Edit),
                      Help => "See RTM User's Manual",
                      Proc => Rtm_Commands(Edit));


--
-- Define the quit command --
--
   Si.Define_Process (Name => Rtm_Command_Representation'Image(Quit),
                      Help => "See RTM User's Manual",
                      Proc => Rtm_Commands(Quit));


--
-- Define the read command --
--
   Si.Define_Process (Name => Rtm_Command_Representation'Image(Read),
                      Help => "See RTM User's Manual",
                      Proc => Rtm_Commands(Read));

   Sa.Define_Argument(Proc => Rtm_Commands(Read),
                      Name    => "name",
                      Help    => "See RTM User's Manual");
```

```
--
-- Define the set command --
--
   Si.Define_Process (Name => Rtm_Command_Representation'Image(Set),
                      Help => "See RTM User's Manual",
                      Proc => Rtm_Commands(Set));

   Sa.Define_Argument(Proc => Rtm_Commands(Set),
                      Name   => "name",
                      Help   => "See RTM User's Manual");

   Sa.Define_Argument(Proc => Rtm_Commands(Set),
                      Name   => "values",
                      Help   => "See RTM User's Manual");

--
-- Define the start command --
--
   Si.Define_Process (Name => Rtm_Command_Representation'Image(Start),
                      Help => "See RTM User's Manual",
                      Proc => Rtm_Commands(Start));

   Sa.Define_Argument(Proc => Rtm_Commands(Start),
                      Name   => "page",
                      Default => "",
                      Help   => "See RTM User's Manual");

   Sa.Define_Argument(Proc => Rtm_Commands(Start),
                      Name   => "update_rate",
                      Default => "2.0",
                      Help   => "See RTM User's Manual");
--
-- Define the stop command --
--
   Si.Define_Process (Name => Rtm_Command_Representation'Image(Stop),
                      Help => "See RTM User's Manual",
                      Proc => Rtm_Commands(Stop));

   Sa.Define_Argument(Proc => Rtm_Commands(Stop),
                      Name   => "page",
                      Default => "",
                      Help   => "See RTM User's Manual");

end Define_Rtm_Cli;
pragma page;
```

```
with String_Pkg;
--
-- Use "string_type" to create a dynamic length for interfacing to
-- the RTM_Cli.
-- Use "length" and "value" to convert the dynamic strings back into
-- normal Ada strings; "length" returns the number of characters in
-- a dynamic string, and "value" returns the characters in the string
-- as a simple Ada string.
--
separate (Define_Rtm_Cli)
procedure Get_Argument (Command: in Rtm_Command_Representation;
                        Argument_Name: in String;
                        Argument_Value: in out String) is
--|*************************************************************
--| Description:
--|   Retrieve an argument from a command line entered by the
--|   user. If the user defaults an argument, then the default
--|   value is returned. The main reason for the existence of this
--|  procedure is twofold:
--|     1. To convert the dynamic strings used in the parser to
--|        the regular strings used by Ada.
--|     2. To blank out any stray characters which may be lingering
--|        in the argument_value string.
--|
--| Parameter Description:
--|   command -> The command that the user entered and is currently
--|              being processed.
--|   argument_name  -> The name of the argument that is needed
--|                     in the command line.
--|   argument_value -> The value entered by the user or the default
--|                     value for the argument.
--|
--| Notes:
--|   none
--|*************************************************************

package Sp renames String_Pkg;
  Interface_String: Sp.String_Type;

  Blanks: String(1..256) := (1..256 => ' ');
begin
  Argument_Value := Blanks(Argument_Value'range );
  Interface_String := Sa.Get_Argument(Proc => Rtm_Commands(Command),
                                      Name => Argument_Name);
  Argument_Value (1..Sp.Length(Interface_String)) :=
             Sp.Value(Interface_String);
exception
  when others =>
    RAISE ;
end Get_Argument;
pragma page;
```

```
separate (Define_Rtm_Cli)
procedure Clear_Command_Line (Command: in Rtm_Command_Representation) is
--/*****************************************************************
--| Description:
--|    Used to reset the parser after a command had been parsed and
--|    processed.
--|
--| Parameter Description:
--|    Command -> The name of the command that was just parsed and
--|               needs to be reset.
--/*****************************************************************
begin
   Si.Redefine_Process (Proc => Rtm_Commands(Command));
end Clear_Command_Line;
pragma page;
```

```
--|*****************************************************************
--| Module Name:
--|    Page_Processor
--|
--| Module Type:
--|    Package Specification
--|
--| Module Purpose:
--|   Processes the user commands which affect pages.
--|-----------------------------------------------------------------
--| Module Description:
--|    This package contains the interface to all the user commands
--|   (dealing with pages) in the RTM User's Manual.
--|
--| References:
--|    Design Documents:
--|      Real-Time Monitor Requirements
--|        Real-Time Monitor Design
--|
--|    User's Manual:
--|        RTM User's Manual
--|
--|    Testing and Validation:
--|        none
--|
--| Notes:
--|    none
--|-----------------------------------------------------------------
--| Modification History:
--|   02Apr87    rlvs    Created
--|
--|-----------------------------------------------------------------
--| Distribution and Copyright Notice:
--|    TBD
--|
--| Disclaimer:
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--|     of Carnegie Mellon University, the U.S. Air Force,
--|     the Department of Defense, or the U.S. Government."
--|*****************************************************************

package Page_Processor is

pragma page;
```

```
   procedure Check_Page;
--/*****************************************************************
--/ Description:
--/   This command checks a page for consistency, i.e., it checks
--/   a page's variables against the variable database to insure
--/   that each one is accessible to the RTM.
--/
--/ Parameter Description:
--/   none
--/*****************************************************************

pragma page;
```

```
   procedure Start_Page;
--/*****************************************************************
--| Description:
--|  Allows the user to select a page for display or history
--|  collection at a penodic update rate.
--|
--| Parameter Description:
--|  none
--/*****************************************************************

pragma page;
```

```
   procedure Stop_Page;
--/*****************************************************************
--| Description:
--|   Allows the user to terminate use of a page.
--|
--| Parameter Description:
--|   none
--/*****************************************************************

pragma page;
```

```
   procedure Update_Pages;
--/*****************************************************************
--| Description:
--|  This entry isused by the monitor to update any pages that
--|  are currently active.  It is not a user command.
--|
--| Parameter Description:
--|  none
--/*****************************************************************

end Page_Processor;
pragma page;
```

```
--|**********************************************************************
--| Module Name:
--|    Page_Processor
--|
--| Module Type:
--|    Package Body
--|
--|----------------------------------------------------------------------
--| Module Description:
--|    This package contains the interface to all the user commands
--|  (dealing with pages) in the RTM User's Manual.  Due to the nature
--|  of the parser used in the RTM, none of the command procedures
--|  need arguments because parser software internally mantains all
--|  arguments for the last parsed line.  This package also defines
--|  structures needed to process the pages (defined below).
--|
--| References:
--|    Design Documents:
--|      Real-Time Monitor Requirements
--|      Real-Time Monitor Design
--|
--|    User's Manual:
--|      RTM User's Manual
--|
--|    Testing and Validation:
--|      none
--|
--| Notes:
--|  none
--|
--|----------------------------------------------------------------------
--| Modification History:
--|  16Apr87    rlvs    created
--|
--|----------------------------------------------------------------------
--| Distribution and Copyright Notice:
--|    TBD
--|
--| Disclaimer:
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--|     of Carnegie Mellon University, the U.S. Air Force,
--|     the Department of Defense, or the U.S. Government."
--|**********************************************************************
pragma page;
```

```
with Calendar; use Calendar;
-- Use type "time"
--
with Dialogue_Manager;
-- Use type "variable_identifier"
--
with Form_Executor;
-- Use type "form_ptr"
--
with Form_Manager;
-- Use types "field_mode", "field_access" and "field_length"
--
with Lists;
-- Use generic package "lists"
-- Use type "list"
-- Use service "create"
--
with Text_Io;
-- Use generic package "fixed_io"
--
with Define_Rtm_Cli; use Define_Rtm_Cli;
--

package Page_Processor is
--
-- Instantiate fixed_io for use in converting strings to type duration
--

package Duration_Io is new Text_Io.Fixed_Io(Duration);
--
-- A page is composed of page information and variables (aka form
-- field names). Processing a page once it has been
-- activated for display requires that the RTM know the name of
-- each variable on the page. The information needed about each
-- variable on a page is:
--    variable_name    -> The name of the variable, which corresponds
--                        to the name of a field on the form representation
--                        of the page where the data are to be displayed.
--    vid ->  A pointer into the variable database, where all the known
--     data on the variable are kept.
--    display_length   -> The size of the output field (on the form) for
--                        this variable.
--
   subtype Variable_Name_Representation is String(1..80);
   type Page_Field_Representation is record
      Variable_Name: Variable_Name_Representation;
      Vid: Dialogue_Manager.Variable_Identifier;
      Display_Length: Integer;
   end record ;
--
-- A page is composed of miscellaneous page data:
--    the_page   ->   A pointer to the form representation of
--           the page. This is used by the form_executor
--           system when updating and displaying the page.
--    page_name  ->   The user's name for the page.
```

```
--    next_update_time   ->  The time when the page is to be refreshed
--                           on the output device.
--    refresh_rate       ->  The rate at which the page is to be refreshed.
-- After the page data comes the data about each of the variables on the
-- page (documented above).  Since the number of variables on a page is
-- variable, a linked list is used to tie them all together for each
-- page:
--    page_fields ->  The linked list of all the legal variables on the
--                    page.
--

package Field_Lists is new Lists (Page_Field_Representation);
   subtype Page_Name_Representation is String(1..80);
   type Page_Representation is record
      The_Page: Form_Executor.Form_Ptr;
      Page_Name: Page_Name_Representation;
      Next_Update_Time: Calendar.Time;
      Refresh_Rate: Duration;
      Page_Fields: Field_Lists.List := Field_Lists.Create;
   end record ;
--
-- For each active page, there is one page_representation record.  All the
-- active pages are kept in an array and added and deleted according to
-- page counts shown below.
--
   Maximum_Number_Of_Active_Pages: constant Integer := 2;
   Current_Number_Of_Active_Pages: Integer := 0;
   Active_Page: array (1..Maximum_Number_Of_Active_Pages) of Page_Representation;

pragma page;
```

```
--
-- Internal procedures
--
   procedure Get_Fields (Field_Pointer: in Form_Manager.Field_Access;
                         The_Variable_Name: in out Variable_Name_Representation;
                         The_Mode: in out Form_Manager.Field_Mode;
                         The_Length: in out Form_Manager.Field_Length) is
                           separate ;

   function  Setup_Page (The_Page: in String;
                         Collection_Rate in Duration)
                         return Integer is separate ;
--
-- Visible procedures
--
   procedure Check_Page is separate ;
   procedure Update_Pages is separate ;
   procedure Start_Page is separate ;
   procedure Stop_Page is separate ;

end Page_Processor;
pragma page;
```

```
with Variable_Database;
-- Use the type "the_variable".
-- Use the service "find".
--
with Rtm_Form; use Rtm_Form;
-- Use the service "put_rtm_field".
--
with Form_Manager; use Form_Manager;
-- Use the types "form_access", "field_access", "field_length"
-- and "field_mode".
-- Use the exception "field_not_found".
-- Use the services "Get_first_field", "Get_next_field" and "modify_field".
--
with Form_Executor;
-- Use the services "access_form" and "modify_field".
-- Use the exception "form_access_error".
--
with Dialogue_Manager;
-- Use the type "variable_identifier".
-- Use the exception "variable_not_found".
-- Use the service "get_identifier".

separate (Page_Processor)
procedure Check_Page is
--|*****************************************************************
--| Description:
--|   This command checks a page for consistency, i.e., it checks
--|   a page's variables against the variable database to insure
--|   that each one is accessible to the RTM.
--|
--| The functioning of this module is very similar to Setup_page.
--| The main difference is that this module doesn't build the
--| actual list of variables; it simply checks the field_mode
--| and existence of each variable, giving the user error messages
--| where appropriate.
--|
--| Parameter Description:
--|   none
--|
--| Notes:
--|   1. All the arguments are obtained from the parser when needed.
--|
--| 2. The exception form_manager.field_not_found is raised
--|    by the form_manager when the end of the form is reached.
--|    This kicks the module out of the loop which builds the variable
--|    list for the page and is the normal exit point for the
--|    module.
--|
--| 3. The exception form_executor.form_access_error is raised
--|    when the form_manager cannot access the user-requested
--|    page. It is propagated out to the caller to indicate
--|    a bad page.
--|*****************************************************************
```

```
package Cli renames  Define_Rtm_Cli;

   The_Variable_Name: Variable_Name_Representation;
   The_Working_Page: Page_Name_Representation;
   A_Variable: Variable_Database.The_Variable;
   The_Page: Form_Manager.Form_Access;
   Error_Count: Integer := 0;

-- declarations needed to access the data in the form_manager
   Field_Pointer: Form_Manager.Field_Access;
   The_Length: Form_Manager.Field_Length := 1;
   The_Mode: Form_Manager.Field_Mode := Constant_Text;

begin
   Cli.Get_Argument (Command => Cli.Check,
             Argument_Name => "page",
             Argument_Value => The_Working_Page);

   The_Page := Form_Executor.Access_Form (Pathname => The_Working_Page);
--
-- Now we loop through all the fields defined for the page, obtaining
-- the variable name and format length from the form_manager, and
-- the variable_identifier from the variable_database,
-- as if we were building the page definition.
--
   Field_Pointer := Form_Manager.Get_First_Field(The_Page);
   loop
     begin
       Get_Fields (Field_Pointer, The_Variable_Name,
             The_Mode, The_Length);
       case  The_Mode is
         when  Constant_Text =>
           null ;
         when  Input_Output =>
           Put_Rtm_Field (Message_Field_A,
                   "illegal mode for variable: " &
                    The_Variable_Name);
           Error_Count := Error_Count + 1;
         when  Output_Only =>
           A_Variable := Variable_Database.Find
             (Name => The_Variable_Name);
       end case ;
     exception
       when  Variable_Database.Variable_Not_Found =>
         Put_Rtm_Field (Message_Field_A,
                 "Variable not_found: " & The_Variable_Name);
         Error_Count := Error_Count + 1;
       when others => --d
         Put_Rtm_Field (Message_Field_B,"exception raised in check...");
     end ;
     Field_Pointer := Form_Manager.Get_Next_Field(Field_Pointer);
   end loop ;
   exception
   when  Form_Manager.Field_Not_Found =>
     Put_Rtm_Field (Message_Field_B,"Check completed with " &
```

```
                        Integer'Image(Error_Count) &
                        " errors");
    when Form_Executor.Form_Access_Error =>
      Put_Rtm_Field (Message_Field_A, "Error in accessing page: " &
                        The_Working_Page);
end Check_Page;
pragma page;
```

```
with Rtm_Form; use Rtm_Form;
-- Use the service "put_rtm_field".
--
separate (Page_Processor)
procedure Start_Page is
--|*****************************************************************
--| Description:
--|  Allows the user to select a page for display or history
--|  collection at a periodic update rate.  The processing is:
--|     1. Get the command arguments.
--|     2. Set up the page definition.
--|     3. Set up the input mode.
--|
--| Parameter Description:
--|    none
--|
--| Notes:
--|  1. All command arguments are obtained from the parser as needed.
--|
--|  2. The exceptions form_executor.invalid_form and
--|     form_executor.form_access_error are raised by Setup_page,
--|     and indicate that a bad page was specified by the user.
--|*****************************************************************

package Cli renames Define_Rtm_Cli;

   End_Of_Value: Integer;
   Collection_Rate: Duration;
   Field_Position: Field_Lists.Listiter;
   The_Page_Fields: Page_Field_Representation;
   Update_Rate: String (1..80);
   Page_Name: Page_Name_Representation;
   Current_Time: Calendar.Time := Calendar.Clock;
   Page_Number: Integer;

begin
   case Current_Number_Of_Active_Pages is
--
-- If we're at the active page limit, issue an error message.
--
      when Maximum_Number_Of_Active_Pages =>
        Put_Rtm_Field (Message_Field_A,
                "Maximum number of active pages already in use");
        Put_Rtm_Field (Message_Field_B,
                "a Stop command must be issued first");
--
-- If we have more active pages available yet, then let the user start
-- another one.
--
      when others =>
--
-- Get the Start command arguments entered by the user and build internal
-- page definition.
--
            Cli.Get_Argument (Command => Cli.Start,
```

```
                    Argument_Name => "page",
                    Argument_Value => Page_Name);
          Cli.Get_Argument (Command => Cli.Start,
                    Argument_Name => "update_rate",
                    Argument_Value => Update_Rate);
          Duration_Io.Get (From => Update_Rate,
                    Item => Collection_Rate,
                    Last => End_Of_Value);
--d
--d       collection_rate := duration(Integer'value(update_rate));
--d
          Page_Number := Setup_Page (Page_Name,Collection_Rate);
          Active_Page(Page_Number).Refresh_Rate := Collection_Rate;
          Active_Page(Page_Number).Next_Update_Time :=
               Current_Time;
--
-- Since we're starting a page, put the user input mode into
-- SCREEN_MODE, which allows the screen to be updated asynchronously
-- from user input.
--
          Rtm_Form.Set_Input_Mode (Rtm_Form.Screen_Mode);
  end case ;
exception
  when Text_Io.Data_Error=>
    Put_Rtm_Field (Message_Field_A,
      "Bad update_rate, reenter in x.xx format");
  when Form_Executor.Invalid_Form
    Form_Executor.Form_Access_Error =>
      null ;
end Start_Page;
pragma page;
```

```
with Case_Insensitive_String_Comparison;
-- Use the service "equal".
--
with Terminal_Interface;
-- Use the service "clear_screen".
--
with Rtm_Form; use Rtm_Form;
-- Use the service "put_rtm_field".
--
separate (Page_Processor)
procedure Stop_Page is
--|*****************************************************************
--| Description:
--|  Allows the user to terminate use of a page.  The processing
--|  is:
--|     1. Search the array of active pages for the user-specified
--|        page.
--|     2. If it's not found, then issue an error message.
--|     3. Otherwise,
--|        a. loop thru all the variables on the page
--|        b. deactivate each one (i.e., remove them from
--|           the list of variables on which data is collected).
--|        c. destroy the page definition.
--|
--| Parameter Description:
--|   none
--|
--| Notes:
--|  1. All command arguments are obtained from the parser as needed.
--|
--|  2. Page_mismatch error renames constraint error; this is used
--|     when searching the active page array for the page to stop.
--|     The constraint_error is raised when the loop exceeds the
--|     dimension of the array, which says that no active page
--|     matches the page which the user wishes to stop, i.e.,
--|     a "page_mismatch".
--|*****************************************************************

package Cisc renames Case_Insensitive_String_Comparison;

package Cli renames Define_Rtm_Cli;

   Field_Position: Field_Lists.Listiter;
   Page_To_Stop: Page_Name_Representation;
   The_Page_Fields: Page_Field_Representation;
   Page_Number: Integer := 1;
   Usage: Dialogue_Manager.Io_Usage := Dialogue_Manager.Read;

   Page_Mismatch: exception renames Constraint_Error;

begin
   case Current_Number_Of_Active_Pages is
--
-- When there are no pages active, then there's nothing to do but
-- inform the user.
```

```
--
      when 0 =>
        Put_Rtm_Field (Message_Field_A,"no active pages to stop");
      when others =>
--
-- Get the name of the page to stop, and compare it against the current
-- active pages; if there's no match, issue an error message (a constraint
-- error is raised when we reach the end of the array), which we have
-- conveniently renamed as a page_mismatch exception.
--
        Cli.Get_Argument (Command => Cli.Stop,
                          Argument_Name => "page",
                          Argument_Value => Page_To_Stop);
        while not Cisc.Equal(Active_Page(Page_Number).Page_Name,Page_To_Stop)
        loop
          Page_Number := Page_Number + 1;
        end loop ;
--
-- If everything is correct, then we iterate through the active variables
-- for the current page, deactivating them in the process.
--
        Field_Position := Field_Lists.Makelistiter(
                            Active_Page(Page_Number).Page_Fields);
        while Field_Lists.More(Field_Position) loop
          Field_Lists.Next(Field_Position,The_Page_Fields);
          Dialogue_Manager.Deactivate (The_Page_Fields.Vid, Usage);

        end loop ;
--
-- When all the variables are deactived, we destroy the active page data,
-- since we just deactivated.
--
        Active_Page(Page_Number).Page_Name (1..10) := "          ";
        Field_Lists.Destroy(Active_Page(Page_Number).Page_Fields);
        Form_Executor.Release_Form
          (Form => Active_Page(Page_Number).The_Page);
        Terminal_Interface.Clear_Screen;
--
-- Move the reset of active pages into the space just vacated by the
-- deletion from the active page list
--
        for New_Page_Number in Page_Number..Current_Number_Of_Active_Pages-1
          loop
          Active_Page(New_Page_Number) := Active_Page(New_Page_Number+1);
          end loop ;
        Current_Number_Of_Active_Pages := Current_Number_Of_Active_Pages-1;
        if Current_Number_Of_Active_Pages = 0 then
          Rtm_Form.Set_Input_Mode (Rtm_Form.Command_Mode);
        end if ;
    end case ;
  exception
--
-- Handle the error that occurs when the user tries to stop a page that
-- isn't active at the moment
--
```

```
      when Page_Mismatch =>
        Put_Rtm_Field (Message_Field_A,
                "Page not currently active: " & Page_To_Stop);
      when others =>
        null ;

    end Stop_Page;
    pragma page;
```

```
separate (Page_Processor)
procedure Update_Pages is
--|*****************************************************************
--| Description:
--|    This entry is used by the monitor to update any pages
--|    which are currently active.  The basic functioning is
--|  straightforward:
--|      1. Loop thru all the currently active pages:
--|         a. if the current time is greater than the next
--|            scheduled update time for the variable,
--|              - loop through all the variables on the page
--|              - place the current value of each into
--|                its field on the page
--|         b. end variable loop
--|         c. display the page to the user
--|      2. End active page loop.
--|
--| Parameter Description:
--|    none
--|
--| Notes:
--|    The collection of data is proceeding in parallel with the
--|  page update operations performed by this module.
--|*****************************************************************

package Cli renames  Define_Rtm_Cli;

   Field_Position: Field_Lists.Listiter;
   The_Page_Fields: Page_Field_Representation;
   The_Value: Dialogue_Manager.Value_String;
   Update_Rate: String (1..80);
   Page_Number: Integer := 1;
   Current_Time: Calendar.Time;

begin
   case  Current_Number_Of_Active_Pages is
      when  0 =>
         null ;
      when  others  =>
         while  Page_Number <= Current_Number_Of_Active_Pages loop
--
-- Determine if it's time to update this page on the display.
--
         Current_Time := Calendar.Clock;
         If  Current_Time >= Active_Page(Page_Number).Next_Update_Time then
--
-- If the time is right, then we create a list iterator,
--
            Field_Position := Field_Lists.Makelistiter(
                     Active_Page(Page_Number).Page_Fields);
--
-- and iterate over all the variables on the current active page,
-- extracting the value from the dialogue_manager and updating
-- the values in the page's internal form representaiton.
--
```

```
            while Field_Lists.More(Field_Position) loop
              Field_Lists.Next(Field_Position,The_Page_Fields);
              The_Value := Dialogue_Manager.Get_Value (
                        The_Page_Fields.Vid,
                        The_Page_Fields.Display_Length);
              Form_Executor.Modify_Field (
                Form => Active_Page(Page_Number).The_Page,
                Field => The_Page_Fields.Variable_Name,
                Value => The_Value(1..The_Page_Fields.Display_Length));
            end loop ;
            Form_Executor.Present_Form (Active_Page(Page_Number).The_Page);
            Active_Page(Page_Number).Next_Update_Time := Current_Time +
              Active_Page(Page_Number).Refresh_Rate;
          end if ;
          Page_Number := Page_Number + 1;
        end loop ;
      end case ;
    exception
      when others =>
        null ;
    end Update_Pages;
    pragma page;
```

```
with Form_Manager; use Form_Manager;
-- Use the types "field_name", "field_mode", "field_length",
--    "field_name", "field_position", "field_renditions", "char_type",
--    "field_value".
-- Use the service "get_field_info".


separate (Page_Processor)
procedure Get_Fields (Field_Pointer: in Form_Manager.Field_Access;
                      The_Variable_Name: in out Variable_Name_Representation;
                      The_Mode: in out Form_Manager.Field_Mode;
                      The_Length: in out Form_Manager.Field_Length) is
--|*********************************************************************
--| Description:
--|   This routine allows the caller to get only the relevant data
--|   from the form_manager's definition of a page, since
--|   not all the data which the form_manager provides are used.
--|   It also does conversion/cleanup work on the data.
--|
--|   The basic operation of this module is:
--|      1. Use the forms management subsystem to get all the data
--|         about the desired field.
--|      2. Blank out any garbage in the variable name.
--|      3. Return the data to the caller.
--|
--| Parameter Description:
--|   field_pointer   -> The pointer to field about which the
--|                      information is needed.  It is the job
--|                      of the caller to determine which field
--|                      is of interest.
--|   the_variable_name  -> The variable name found in the field
--|                         (to the form_manager, it is the name of the
--|                          field; to the RTM, it is the variable name).
--|   the_mode    -> The I/O mode of the variable:
--|                  INPUT_OUTPUT or OUTPUT_ONLY
--|   the_length  -> The number of characters allowed on the form
--|                  for displaying the data of the variable.
--|
--| Notes:
--|    none
--|*********************************************************************

   Blanks: Variable_Name_Representation := (others => ' ');

-- Declarations needed to access the data in the form_manager:
   The_Field_Name: Form_Manager.Field_Name;
   The_Location: Form_Manager.Field_Position;
   The_Rendition: Form_Manager.Field_Renditions;
   The_Limits: Form_Manager.Char_Type;
   The_Initial_Value: Form_Manager.Field_Value;
   The_Current_Value: Form_Manager.Field_Value;

begin
--
-- Get all the information for the next field on the page from the
```

```
-- form manager.
--
   Form_Manager.Get_Field_Info (
      Field => Field_Pointer,
      Name => The_Field_Name,
      Position => The_Location,
      Length => The_Length,
      Rendition => The_Rendition,
      Char_Limits => The_Limits,
      Init_Value => The_Initial_Value,
      Value => The_Current_Value,
      Mode => The_Mode);
--
-- Clean up the variable name so that there's no garbage variable name
-- we return to the caller.
--
      The_Variable_Name := Blanks;
      The_Variable_Name(1..The_Field_Name'Last) := The_Field_Name;

end Get_Fields;
pragma page;
```

```
with Variable_Database;
-- Use the type "the_variable".
-- Use the exception "variable_not_found".
-- Use the service "find".
--
with Rtm_Form; use Rtm_Form;
-- Use the service "put_rtm_field".
--
with Form_Manager; use Form_Manager;
-- Use the types "form_access", "field_access", "field_length"
-- and "field_mode".
-- Use the exception "field_not_found"
-- Use the services "Get_first_field", "Get_next_field" and "modify_field".
--
with Form_Executor;
-- Use the services "access_form" and "modify_field".
-- Use the exception "form_access_error".
--
with Dialogue_Manager;
-- Use the type "variable_identifier" and "ic_usage".
-- Use the exception "variable_not_found".
-- Use the service "activate".

separate (Page_Processor)
function Setup_Page (The_Page: in String;
                     Collection_Rate: in Duration) return Integer is
--|*****************************************************************
--| Description:
--|   This module takes a page name and uses services from the
--|   form_manager to build the internal representation of a page.
--|
--|   The processing performed by this module is:
--|     1. Check to see that the page exits, and if not,
--|        issue an error to the  user and exception out.
--|     2. When the page exists, the module loops through
--|        all the fields on the form, building the list
--|        of page variables from the INPUT_OUTPUT and
--|        OUTPUT_ONLY fields and activating the variables
--|        for data collection.
--|
--| Parameter Description:
--|  the_page   -> The user's name for the page to be invoked.
--|  return  -> The index into the active page array where the
--|             page definition has been built.
--|
--| Notes:
--|  1. The exception form_manager.field_not_found is raised
--|     by the form_manager when the end of the form is reached.
--|     This kicks the module out of loop which builds the variable
--|     list for the page, and is the normal exit point for the
--|     module.
--|  2. The exception form_executor.form_access_error is raised
--|     when the forms management subsystem  cannot access the
--|     user-requested page.  It is propagated out to the caller
--|     to indicate a bad page.
```

```
--/**********************************************************

 package Cli renames  Define_Rtm_Cli;

   Current_Time: Calendar.Time := Calendar.Clock;
   Page_Number: Integer;
   A_Variable: Variable_Database.The_Variable;
   Active_Variable: Dialogue_Manager.Variable_Identifier;
   Temporary_Form: Form_Manager.Form_Access;
   The_Variable_Name: Variable_Name_Representation;


-- Declarations needed to access the data in the form_manager:
   Field_Pointer: Form_Manager.Field_Access;
   The_Length: Form_Manager.Field_Length := 1;
   The_Mode: Form_Manager.Field_Mode := Constant_Text;

 begin
 --
 -- Set up an active page definition for the page selected by the user.
 --    1. Load the form defintion for the page selected by the user.
 --    2. Increment the count of the number of active pages.
 --    3. Store the pointer to the form definition and the name of the page.
 --
   Temporary_Form := Form_Executor.Access_Form (Pathname => The_Page);
   Current_Number_Of_Active_Pages := Current_Number_Of_Active_Pages + 1;
   Page_Number := Current_Number_Of_Active_Pages;
   Active_Page(Page_Number).The_Page := Temporary_Form;
   Active_Page(Page_Number).Page_Name := The_Page;
 --
 -- Once all the form level items are set up,
 -- we loop through all the fields defined for the form/page, obtaining
 -- the variable name and format length from the form_manager, and
 -- the variable_identifier from the variable_database; using this, we
 -- activate the variable for data collection and build the page field
 -- definition by creating a list of
 -- (variable_name, variable_identifier, format length) records.

 --
   Field_Pointer := Form_Manager.Get_First_Field
                (Active_Page(Page_Number).The_Page);
   loop
     begin
       Get_Fields (Field_Pointer, The_Variable_Name,
             The_Mode, The_Length);
       case  The_Mode is
 --
 --     Constant_text fields are trim items on the form and
 --     not of interest to the RTM.
 --
         when  Constant_Text =>
           null ;
 --
 --    Input_output fields contain variables of interest, but were
 --    entered inappropriately by the user, so we change the mode and
```

```
--    use the fields appropriately.
--
          when Input_Output =>
            Form_Manager.Modify_Field_Mode (Field => Field_Pointer,
                                            Mode => Output_Only);
            A_Variable := Variable_Database.Find
              (Name => The_Variable_Name);
            Active_Variable := Dialogue_Manager.Activate
              (The_Variable_Name,
               Collection_Rate,
               Current_Time,
               Dialogue_Manager.Read);
            Field_Lists.Attach (Active_Page(Page_Number).Page_Fields.
                    (Variable_Name => The_Variable_Name,
                     Vid => Active_Variable,
                     Display_Length => The_Length));
--
--    These fields also contain variables of interest to the user,
--    but are a little simpler, since they are already in the
--    proper mode.
--
          when Output_Only =>
            A_Variable := Variable_Database.Find
              (Name => The_Variable_Name);
            Active_Variable := Dialogue_Manager.Activate
              (The_Variable_Name,
               Collection_Rate,
               Current_Time,
               Dialogue_Manager.Read);
            Field_Lists.Attach (Active_Page(Page_Number).Page_Fields,
                    (Variable_Name => The_Variable_Name,
                     Vid => Active_Variable,
                     Display_Length => The_Length));
          end case ;
        exception
          when Variable_Database.Variable_Not_Found |
             Dialogue_Manager.Variable_Not_Found =>
            Form_Executor.Modify_Field
              (Form => Active_Page(Page_Number).The_Page,
               Field => The_Variable_Name,
               Value => "error.....");
            Put_Rtm_Field (Message_Field_A, "Variable not found: " &
                                        The_Variable_Name);
          when others => --debug
            Put_Rtm_Field (Message_Field_B,"exception raised in setup...");
        end ;
        Field_Pointer := Form_Manager.Get_Next_Field(Field_Pointer);
      end loop ;
    exception
--
--  When the form_manager runs out of fields, the end of the form is reached;
--  this is the normal exit point for the module.
--
      when Form_Manager.Field_Not_Found =>
        RETURN Page_Number;
```

```
    when Form_Executor.Form_Access_Error =>
      Put_Rtm_Field (Message_Field_A,
              "Error in accessing page: " & The_Page);
      RAISE ;
end Setup_Page;
pragma page;
```

```
--|*****************************************************************
--| Module Name:
--|    Parameter_Manager
--|
--| Module Type:
--|    Package Specification
--|
--| Module Purpose:
--|  Manages the reading and writing of single Ada variables
--|  independently of displaying pages.
--|-----------------------------------------------------------------
--| Module Description:
--|    This package manages the reading and writing of single Ada
--|  variables without interfering with active display pages.
--|
--| References:
--|    Design Documents:
--|      Real-Time Monitor Requirements
--|        Real-Time Monitor Design
--|
--|    User's Manual:
--|        RTM User's Manual
--|
--|    Testing and Validation:
--|        none
--|
--| Notes:
--|  none
--|-----------------------------------------------------------------
--| Modification History:
--|  08Apr87    rlvs    Created
--|
--|-----------------------------------------------------------------
--| Distribution and Copyright Notice:
--|    TBD
--|
--| Disclaimer:
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--|     representing official policies,  either  expressed or implied,
--|     of Carnegie Mellon University, the U.S. Air Force,
--|     the Department of Defense, or the U.S. Government."
--|*****************************************************************
pragma page;
```

```
package Parameter_Manager is

   procedure Read;
--/*****************************************************************
--| Description:
--|   Extracts the value of a variable from application memory.
--|
--| Parameter Description:
--|   none
--/*****************************************************************

pragma page;
```

```
   procedure Set;
--|*****************************************************************
--| Description:
--|   Deposits the user-supplied value into application memory.
--|
--| Parameter Description:
--|   none
--|*****************************************************************

end Parameter_Manager;
pragma page;
```

```
--|*****************************************************************
--| Module Name:
--|    Parameter_manager;
--|
--| Module Type:
--|    Package Body
--|
--|-------------------------    ---------------------------------
--| Module Description:
--|    This package implements two commands:
--|
--|      Read (name => <variable>);
--|      Set  (name => <variable>, value => <  >);
--|  The package does very little except group the single variable
--|  operations together.
--|
--| References:
--|    Design Documents:
--|      Real-Time Monitor Requirements
--|        Real-Time Monitor Design
--|
--|    User's Manual:
--|        RTM User's Manual
--|
--|    Testing and Validation:
--|        none
--|
--| Notes:
--|    none
--|-----------------------------------------------------------------
--| Modification History:
--|  30Apr87    rlvs    created
--|
--|-----------------------------------------------------------------
--| Distribution and Copyright Notice:
--|    TBD
--|
--| Disclaimer:
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--|     representing official policies,  either  expressed or implied,
--|     of Carnegie Mellon University, the U.S. Air Force,
--|     the Department of Defense, or the U.S. Government."
--|*****************************************************************
pragma page;
```

```
package Parameter_Manager is
--
-- Internal procedures
--
function Left_Justify (Display_Value in String)
  return String is separate;
--
-- Visible procedures
--
  procedure Read is separate;
  procedure Set is separate;

end Parameter_Manager;
pragma page;
```

```
with Dialogue_Manager,
   -- Use the types "variable_identifier" and "value_string".
   -- Use the services "activate", "get_value", "get_identifier" and
   -- "deactivate"
   --
with Define_Rtm_Cli,
   -- Use the service "get_argument".
   --
with Rtm_Form, use Rtm_Form,
   -- Use the service "put_rtm_field"
   --
with Calendar, use Calendar,
   -- Use the type "time".
   -- Use the service "clock".
   --

separate (Parameter_Manager)
procedure Read is
   --|*****************************************************************
   --| Description:
   --|   Extracts the value of a variable from application memory.
   --|   The processing involved is straightforward:
   --|      1. Get the variable to be read from the user's
   --|         command line.
   --|      2. If the variable is not in the database, then
   --|         issue an error message and get out.
   --|      3. Otherwise,
   --|         a. activate the variable for input,
   --|         b. read the value ,
   --|         c. display the value to the user,
   --|         d. and deactivate the variable (since we're finished with it).
   --|
   --| Parameter Description:
   --|   none
   --|
   --| Notes:
   --|   none
   --|*****************************************************************

package Cli renames Define_Rtm_Cli,

   The_Variable: Dialogue_Manager.Variable_Identifier,
   The_Value: Dialogue_Manager.Value_String,
   Variable_Name: String (1..80),
   Current_Time: Calendar.Time := Clock,
begin
   --
   -- Get the variable name and verify that it's legal.
   --
   Cli.Get_Argument (Command => Cli.Read,
                     Argument_Name => "name",
                     Argument_Value => Variable_Name),
   --
   -- Activate the variable, extract the data, and display it to the user
   --
```

```
    The_Variable := Dialogue_Manager.Activate
      (Name => Variable_Name,
       Usage => Dialogue_Manager.Read,
       Starting_Time => Current_Time,
       Rate => 0.0);
    The_Value := Left_Justify(Dialogue_Manager.Get_Value (Vid=>The_Variable));
    Put_Rtm_Field (Field => Message_Field_A,
                   Field_Value => "Variable : " & Variable_Name);
    Put_Rtm_Field (Field => Message_Field_B,
                   Field_Value => "has the value: " & The_Value);
    Dialogue_Manager.Deactivate (Vid => The_Variable,
                                 Usage => Dialogue_Manager.Read);
exception
  when Dialogue_Manager.Variable_Not_Found =>
    Put_Rtm_Field (Field => Message_Field_A,
                   Field_Value => "Variable not Found: " & Variable_Name);
  when others =>
    Put_Rtm_Field (Field => Message_Field_A,
                   Field_Value => "Unhandled exception in param_man");
end Read;
pragma page;
```

```
with Dialogue_Manager;
-- Use the types "variable_identifier" and "value_string".
-- Use the services "activate", "get_value", "get_identifier" and
-- "deactivate".
--
with Define_Rtm_Cli;
-- Use the service "get_argument".
--
with Rtm_Form; use Rtm_Form;
-- Use the service "put_rtm_field".
--
with Calendar; use Calendar;
-- Use the type "time".
-- Use the service "clock".
--

separate (Parameter_Manager)
procedure Set is
--|*********************************************************************
--| Description:
--|  Deposits the user-supplied value into application memory.
--|  The processing ivolved is straightforward:
--|     1. Get the variable and value to write from the user's
--|        command line.
--|     2. If the variable is not in the database, then
--|        issue an error message and get out.
--|     3. Otherwise,
--|        a. activate the variable for output,
--|        b. display the status to the user,
--|        c. and deactivate the variable (since we're finished with it).
--|
--| Parameter Description:
--|  none
--|
--| Notes:
--|  none
--|*********************************************************************

package Cli renames Define_Rtm_Cli;

   The_Variable: Dialogue_Manager.Variable_Identifier;
   The_New_Value: Dialogue_Manager.Value_String;
   The_Value: Dialogue_Manager.Value_String;
   Variable_Name: String (1..80);
   Current_Time: Calendar.Time := Clock;
begin
--
-- Get the variable_name and value entered by the user and
-- verify that the variable is available for i/o.
--
   Cli.Get_Argument (Command => Cli.Set,
                     Argument_Name => "name",
                     Argument_Value => Variable_Name);
   Cli.Get_Argument (Command => Cli.Set,
                     Argument_Name => "values",
```

```
                Argument_Value => The_New_Value);
--
-- Deposit the data into application memory and display the status.
-- The Activate procedure call must precede the Set_Value procedure call,
-- since Set_Value requires a variable_identifier to function properly.
--
   The_Variable := Dialogue_Manager.Activate
      (Name => Variable_Name,
       Usage => Dialogue_Manager.Write,
       Starting_Time => Current_Time,
       Rate => 0.0);
   Dialogue_Manager.Set_Value (Vid => The_Variable,
                       Value => The_New_Value);
   The_Value := Left_Justify(Dialogue_Manager.Get_Value (Vid=>The_Variable));
   Put_Rtm_Field (Field => Message_Field_A,
             Field_Value => "Variable : " & Variable_Name);
   Put_Rtm_Field (Field => Message_Field_B,
             Field_Value => "now has the value: " & The_Value);
   Dialogue_Manager.Deactivate (Vid => The_Variable,
                       Usage => Dialogue_Manager.Write);
exception
   when Dialogue_Manager.Variable_Not_Found =>
      Put_Rtm_Field (Field => Message_Field_A,
                Field_Value => "Variable not Found: " & Variable_Name);
   when Dialogue_Manager.Illegal_Value =>
      Put_Rtm_Field (Field => Message_Field_A,
                Field_Value => "Illegal value: " & The_New_Value);
      Dialogue_Manager.Deactivate (Vid => The_Variable,
                          Usage => Dialogue_Manager.Write);
   when others =>
      Put_Rtm_Field (Field => Message_Field_A,
                Field_Value => "Unhandled exception in param_man");
end Set;
pragma page;
```

```
separate (Parameter_Manager)
function Left_Justify (Display_Value: in String)
  return String is
--/*****************************************************************
--| Description:
--|   This function takes a string as input and strips off leading
--| blanks.
--|
--| Parameter Description:
--|   display_value ->   String to process.
--|   return        ->  left-justified string
--|
--| Notes:
--|   none
--/*****************************************************************
  String_Length: Integer := Display_Value'Length;
  Starting_Character: Integer := String_Length;
  New_String: String(Display_Value'range ) := (others => ' ');
begin
  if Display_Value(1) /= ' ' then
    RETURN Display_Value;
  else
    while Display_Value(Starting_Character) /= ' ' loop
      Starting_Character := Starting_Character - 1;
    end loop ;
    New_String (1..String_Length - Starting_Character + 1) :=
      Display_Value(Starting_Character..Display_Value'Length);
    RETURN New_String;
    end if ;
end Left_Justify;
pragma page;
```

```
--/*****************************************************************
--| Module Name:
--|    Conversions
--|
--| Module Type:
--|    Package Specification
--|
--| Module Purpose:
--|    This package ties all the generic conversion packages together
--|  and provides their common utilities and exceptions.
--|-----------------------------------------------------------------
--| Module Description:
--|
--| References:
--|    Design Documents:
--|      Real-Time Monitor Requirements
--|        Real-Time Monitor Design
--|
--|    User's Manual:
--|        RTM User's Manual
--|
--|    Testing and Validation:
--|        none
--|
--| Notes:
--|    none
--|-----------------------------------------------------------------
--| Modification History:
--|  02Sep87    rlvs    created
--|
--|-----------------------------------------------------------------
--| Distribution and Copyright Notice:
--|    TBD
--|
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--|     of Carnegie Mellon University, the U.S. Air Force,
--|     the Department of Defense, or the U.S. Government."
--|*****************************************************************
pragma page;
```

```
with System;
-- Use the type "Address".
--

package Conversions is

--/*********************************************************************
--/
--/  Exceptions
--/
--/*********************************************************************
--
-- Signals that the value in the character string is the wrong type
-- for the variable.  This exception is shared among all the
-- generic conversion packages.
--
Illegal_Value:  exception ;


pragma page;
```

```
--|*****************************************************************
--| Module Name:
--|    Convert_Integers
--|
--| Module Type:
--|    Package Specification
--|
--| Module Purpose:
--|    This is a package of generic utilities to convert binary bit strings
--|  into integer character strings and character strings into
--|  binary bit strings.
--|-----------------------------------------------------------------
--| Module Description:
--|    This package contains two generic procedures used for converting
--|  from integer binary bit strings to integer character strings.
--|  The package is set up to operate in a two-CPU configuration, with
--|  the generic function target_conversion doing any needed translations
--|  from the target numeric representation into the host numeric
--|  representation.
--|
--| References:
--|    Design Documents:
--|      Real-Time Monitor Requirements
--|        Real-Time Monitor Design
--|
--|    User's Manual:
--|        RTM User's Manual
--|
--|    Testing and Validation:
--|        none
--|
--| Notes:
--|    none
--|-----------------------------------------------------------------
--| Modification History:
--|  04Jun87    rlvs    created
--|
--|-----------------------------------------------------------------
--| Distribution and Copyright Notice:
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--|
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--|     of Carnegie Mellon University, the U.S. Air Force,
--|     the Department of Defense, or the U.S. Government."
--|*****************************************************************
pragma page;
```

```
generic
--
-- Default width of the generated character strings.
   Width: Positive := 15;
--
-- Integer source_representation (this is the host machine's type)
   type Source_Representation is range <>;
--
-- Low-level conversion routine needed to convert from the target
-- representation to the host representation of the source type
-- (referred to as source_representation)
   with function Target_Conversion (Raw_Value: in System.Address)
     return Source_Representation;



package Convert_Integers is

   procedure Make_String (Raw_Value: in System.Address;
                          Field_Size: in Integer := Width;
                          Value: out String);
--|*********************************************************************
--| Description:
--|   Make_string takes a binary bit string and converts it into
--| an integer character string.
--|
--| Parameter Description:
--| raw_value  -> The address of the binary bit string to be
--|               converted.
--| field_size -> The number of characters needed in the output
--|               string.
--| value  -> The character image of the binary bit string as
--|           an integer.
--|*********************************************************************

   procedure Make_Value (Raw_Value: in String;
                         Value: in System.Address);
--|*********************************************************************
--| Description:
--|   Make_value takes an integer character string and converts it into a
--| binary bit string.
--|
--| Parameter Description:
--| raw_value  -> The character string to be converted.
--| value  -> The address where the resulting bit string is to be
--|           stored.
--|*********************************************************************

end Convert_Integers;

pragma page;
```

```
--|*****************************************************************
--| Module Name:
--|    Convert_Floats
--|
--| Module Type:
--|    Package Specification
--|
--| Module Purpose:
--|    This is a package of generic utilities to convert binary bit strings
--|  into real character strings and character strings into
--|  binary bit strings.
--|-----------------------------------------------------------------
--| Module Description:
--|    This package contains two generic procedures used for converting
--|  from real binary bit strings to real character strings.
--|  The package is set up to operate in a two-CPU configuration, with
--|  the generic function target_conversion doing any needed translations
--|  from the target numeric representation into the host numeric
--|  representation.
--|
--| References:
--|    Design Documents:
--|      Real-Time Monitor Requirements
--|       Real-Time Monitor Design
--|
--|    User's Manual:
--|       RTM User's Manual
--|
--|    Testing and Validation:
--|       none
--|
--| Notes:
--|    none
--|-----------------------------------------------------------------
--| Modification History:
--|  04Jun87    rlvs    created
--|
--|-----------------------------------------------------------------
--| Distribution and Copyright Notice:
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--|
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--|     of Carnegie Mellon University, the U.S. Air Force,
--|     the Department of Defense, or the U.S. Government."
--|*****************************************************************
pragma page;
```

```
generic
--
-- Default width of the generated character strings.
--
   Width: Positive := 15;
--
-- Integer type source, this is the host machine's type
--
   type Source_Representation is digits <>;
--
-- Low-level conversion routine needed to convert from the target
-- representation to the host representation of the source type
-- (referred to as source_representation)
--
   with function Target_Conversion (Raw_Value: in System.Address)
     return Source_Representation;


package Convert_Floats is

   procedure Make_String (Raw_Value: in System.Address;
                          Field_Size: in Integer := Width;
                          Value: out String);
--|*****************************************************************
--| Description:
--|   Make_string takes a binary bit string and converts it into
--|  a real character string.
--|
--| Parameter Description:
--|  raw_value  -> The address of the binary bit string to be
--|                converted.
--|  field_size -> The number of characters needed in the output
--|                string.
--|  value  -> The character image of the binary bit string as
--|            a float.
--|*****************************************************************

   procedure Make_Value (Raw_Value: in String;
                         Value: in System.Address);
--|*****************************************************************
--| Description:
--|   Make_value takes a real character string and converts it into a
--|  binary bit string.
--|
--| Parameter Description:
--|  raw_value  -> The character string to be converted
--|  value  -> The address where the resulting bit string is to be
--|            stored.
--|*****************************************************************

end Convert_Floats;

pragma page;
```

```
--|*****************************************************************
--| Module Name:
--|    Convert_Enumerations
--|
--| Module Type:
--|    Package Specification
--|
--| Module Purpose:
--|    This is a package of generic utilities to convert binary bit strings
--|    into enumeration character strings and character strings into
--|    binary bit strings.
--| ---------------------------------------------------------------
--| Module Description:
--|    This package contains two generic procedures used for converting
--|    from enumeration binary bit strings to enumeration character strings.
--|    The package is set up to operate in a two-CPU configuration, with
--|    the generic function target_conversion doing any needed translations
--|    from the target numeric representation into the host numeric
--|    representation.
--|
--| References:
--|    Design Documents:
--|       Real-Time Monitor Requirements
--|       Real-Time Monitor Design
--|
--|    User's Manual:
--|       RTM User's Manual
--|
--|    Testing and Validation:
--|       none
--|
--|  Notes:
--|    none
--| ---------------------------------------------------------------
--|  Modification History:
--|    04Jun87   mvs   created
--|
--| ---------------------------------------------------------------
--|  Distribution and Copyright Notice:
--|    TBD
--|
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--|    of Carnegie Mellon University, the U.S. Air Force,
--|    the Department of Defense, or the U.S. Government."
--|*****************************************************************

pragma page
```

```
generic
--
-- Default width of the generated character strings.
--
   Width: Positive := 15;
--
-- Integer type source, this is the host machine's type
--
   type Source_Representation is (<>);
--
-- Low-level conversion routine needed to convert from the target
-- representation to the host representation of the source type
-- (referred to as source_representation)
--
   with function Target_Conversion (Raw_Value: in System.Address)
     return Source_Representation;


package Convert_Enumerations is

   procedure Make_String (Raw_Value: in System.Address;
                          Field_Size: in Integer := Width;
                          Value: out String);
--|*****************************************************************
--| Description:
--|   Make_value takes a enumeration character string and converts it into a
--|  binary bit string.
--|
--| Parameter Description:
--|  raw_value  -> The character string to be converted.
--|  field_size -> The number of characters needed in the output
--|                string.
--|  value  -> The address where the resulting bit string is to be
--|            stored.
--|*****************************************************************

   procedure Make_Value (Raw_Value: in String;
                         Value: in System.Address);
--|*****************************************************************
--| Description:
--|   Make_value takes an enumeration character string and converts it into a
--|  binary bit string.
--|
--| Parameter Description:
--|   raw_value  -> The character string to be converted.
--|   value  -> The address where the resulting bit string is to be
--|             stored.
   *****************************************************************

end Convert_Enumerations;

end Conversions.
pragma page
```

```
--------------------------------------------------------------------------
Module Name
    [illegible]

Module Type
    [illegible]

Module Description
    [illegible]
    [illegible]

References
  Design Documents
    [illegible]
    [illegible]

  User's Manual
    [illegible]

  Testing and validation
    [illegible]

Notes
    [illegible]

Modification History
    [illegible]

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Disclaimer
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    [illegible]
    [illegible]
    [illegible]
    [illegible]
    [illegible]
--------------------------------------------------------------------------
pragma page
```

```
package Conversions is

   package Convert_Integers is separate

   package Convert_Floats is separate

   package Convert_Enumerations is separate

end Conversions
pragma PAGE
```

```
--|*****************************************************************
--| Module Name:
--|    Convert_Integers
--|
--| Module Type:
--|    Package Body
--|
--|-----------------------------------------------------------------
--| Module Description:
--|    This package contains two generic procedures used for converting
--|    from integer binary bit strings to integer character strings.
--|    It does this using the services of text_io and unchecked conversion.
--|
--| References:
--|    Design Documents:
--|       none
--|
--|    Testing and Validation:
--|       none
--|
--| Notes:
--|    none
--|-----------------------------------------------------------------
--| Modification History:
--|    04Jun87    rlvs    created
--|
--|-----------------------------------------------------------------
--| Distribution and Copyright Notice:
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--|    of Carnegie Mellon University, the U.S. Air Force,
--|    the Department of Defense, or the U.S. Government."
--|*****************************************************************
pragma page;
```

```
with Text_Io;
-- Need services "put" and "get".
--
with Unchecked_Conversion;
-- Need service "unchecked_conversion".
--
separate (Conversions)

package Convert_Integers is
--
-- Instantiate an io package to manipulate integer types.
--

package Internal_Io is new Text_Io.Integer_Io (Source_Representation);
--
-- Create type and objects needed to access memory as integer values,
-- given system addresses as input.
--
   type Integer_Pointer is access Source_Representation;
   New_Integer_Value: Integer_Pointer;
   function Address_To_Integer_Pointer is new Unchecked_Conversion
      (Source => System.Address,
       Target => Integer_Pointer);
   function Integer_Pointer_To_Address is new Unchecked_Conversion
      (Source => Integer_Pointer,
       Target => System.Address);

pragma page;
```

```
procedure Make_String (Raw_Value in System.Address
                       Field_Size in Integer := Width
                       Value out String) is
--|*****************************************************************
--| Description:
--|   Make_string takes a binary bit string and converts it into
--|   an integer character string.  It does this by using
--|  target_conversion to map the target bit representation of an
--|  integer into the host version of an integer and then
--|  uses text_io to convert the bits into an integer character string
--|
--| Parameter Description:
--|   raw_value  -> The address of the binary bit string to be
--|                 converted
--|   field_size -> The number of characters needed in the output
--|                 string
--|   value      -> The character image of the binary bit string as
--|                 an integer
--|
--| Notes:
--|   none
--|*****************************************************************
begin
  Internal_Io.Put(To => Value(1..Field_Size),
                  Item => Target_Conversion(Raw_Value));
exception
  when Text_Io.Layout_Error =>
    Value(1..Field_Size) := (1..Field_Size => '*');
  when others =>
    RAISE;
end Make_String;


pragma page
```

```
procedure Make_Value_Raw_Value (In_String
          : in String; Value : in System.Address) is
   ------------------------------------------------------------
```

Description

Parameter Description

Notes

```
   ------------------------------------------------------------
begin
exception
   when
      RAISE
   when others
      RAISE
end Make_Value_Raw_Value;

end
pragma
```

Module Name

Module Type

Module Description

References

Design Documents

Testing and Validation

Notes

Modification History

Distribution and Copyright Notice

Disclaimer

pragma

```
with Text_Io
   Need services "put" and "get"

with Unchecked_Conversion
   Need service "unchecked_conversion"

separate (Conversions)

package Convert_Floats is

   Instantiate this package to manipulate float types


package Internal_Io is new Text_Io.Float_Io (Source_Representation)

   Create type and objects needed to access memory as float values
   given system addresses as input

   type Real_Pointer is access Source_Representation;
   New_Real_Value : Real_Pointer;
   function Address_To_Real_Pointer is new Unchecked_Conversion
      (Source => System.Address;
       Target => Real_Pointer);
   function Real_Pointer_To_Address is new Unchecked_Conversion
      (Source => Real_Pointer;
       Target => System.Address);

pragma [illegible]
```

```
procedure Make_String (Raw_Value: in System.Address;
                       Field_Size: in Integer := Width;
                       Value: out String) is
--|*****************************************************************
--| Description:
--|    Make_string takes a binary bit string and converts it into
--|    a real character string.  It does this by using
--|  target_conversion to map the target bit representaion of a
--|  real into the host version of a real and then
--|  uses text_io to convert the bits into a real character string.
--|
--| Parameter Description:
--|    raw_value  -> The address of the binary bit string to be
--|                  converted.
--|    field_size -> The number of characters needed in the output
--|                  string.
--|    value  -> The character image of the binary bit string as
--|              a real.
--|
--| Notes:
--|    none
--|*****************************************************************
begin
   Internal_Io.Put (To => Value(1..Field_Size),
                    Item => Target_Conversion(Raw_Value));
exception
   when Text_Io.Layout_Error =>
      Value(1..Field_Size) := (1..Field_Size => '*');
   when others =>
      RAISE;
end Make_String;

pragma page
```

```
procedure Make_Value (Raw_Value: In String;
                      Value: In System.Address) is
--|*****************************************************************
--| Description:
--|   Make_value takes a real character string and converts it
--|   into a binary bit string.  It does this by converting
--|  the address where the data are to be stored into a pointer
--|  to a real and then uses text_io to get a real out of
--|  a string and store it at the pointer.
--|
--| Parameter Description:
--|   raw_value  -> The character string to be converted.
--|   value  -> The address where the resulting bit string is to be
--|             stored.
--|
--| Notes:
--|   none
--|*****************************************************************
   Value_Location: Real_Pointer := Address_To_Real_Pointer(Value);
   End_Of_Value: Integer;
begin
      Internal_Io.Get (From => Raw_Value,
                       Item => Value_Location.all,
                       Last => End_Of_Value);
exception
   when Text_Io.Data_Error =>
      RAISE Illegal_Value;
   when others =>
      RAISE;
end Make_Value;

end Convert_Floats;
pragma page
```

```
--|*****************************************************************
--| Module Name:
--|    Convert_Enumerations
--|
--| Module Type:
--|    Package Body
--|
--|-----------------------------------------------------------------
--| Module Description:
--|    This package contains two generic procedures used for converting
--|    from real binary bit strings to real character strings.
--|    It does this using the services of text_io and unchecked_conversion.
--|
--| References:
--|    Design Documents:
--|       none
--|
--|    Testing and Validation:
--|       none
--|
--| Notes:
--|    none
--|-----------------------------------------------------------------
--| Modification History:
--|    04Jun87   rlvs   created
--|
--|-----------------------------------------------------------------
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--|
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--|     the Department of Defense, or the U.S. Government."
--|*****************************************************************

pragma page
```
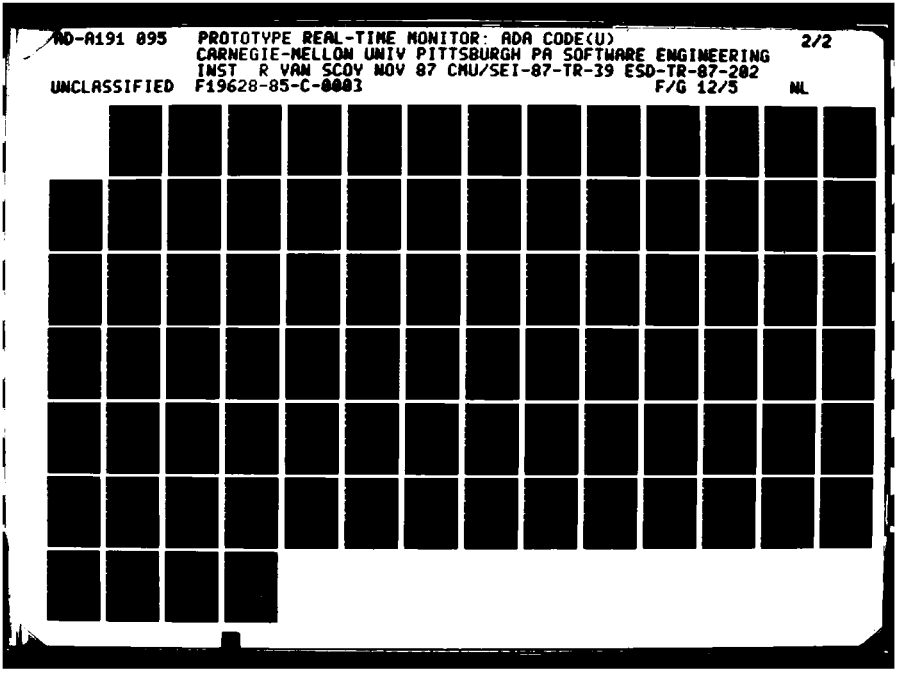
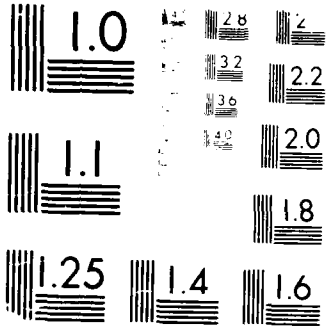

```
with Text_IO;
   Need services "Put" and "Get"

with Unchecked_Conversion;
   Need service "Unchecked_Conversion"

separate (Conversions)

package Convert_Enumeration is

   -- Standard part of package to "Put" and "Get" enumeration values


package Internal_IO is new Text_IO.Enumeration_IO (Source_Representation);

   Create type and objects needed to access memory as enumeration values
   given system addresses as input

   type Enum_Pointer is access Source_Representation;
   New_Enum_Value : Enum_Pointer;
   function Address_To_Enum_Pointer is new Unchecked_Conversion
      (Source => System.Address;
       Target => Enum_Pointer);
   function Enum_Pointer_To_Address is new Unchecked_Conversion
       (Source => Enum_Pointer;
        Target => System.Address);

pragma page;
```

```
procedure Make_String (Raw_Value In System.Address;
                       Field_Size In Integer := Width;
                       Value out String) is
   ------------------------------------------------------------------
   Description:
      Make_string takes a binary bit string and converts it into
      an enumeration character string.  It does this by using
   target_conversion to map the target bit representaion of an
   enumeration into the host version of an enumeration and then
   uses text_io to convert the bits into an enumeration character string.
--
   Parameter Description:
      raw_value  -> The address of the binary bit string to be
--                    converted.
--    field_size -> The number of characters needed in the output
--                    string.
--    value      -> The character image of the binary bit string as
--                  an enumeration.
--
--  Notes:
--    none
--  ------------------------------------------------------------------
begin
   Internal_Io.Put (To => Value(1..Field_Size),
                    Item => Target_Conversion(Raw_Value));
exception
   when Text_Io.Layout_Error =>
      Value(1..Field_Size) := (1..Field_Size => '*');
   when others =>
      RAISE ;
end Make_String;

pragma page;
```


AD-A191 095 PROTOTYPE REAL-TIME MONITOR: ADA CODE(U) 2/2
CARNEGIE-MELLON UNIV PITTSBURGH PA SOFTWARE ENGINEERING
INST R VAN SCOY NOV 87 CMU/SEI-87-TR-39 ESD-TR-87-202
UNCLASSIFIED F19628-85-C-0003 F/G 12/5 NL



MICROCOPY RESOLUTION TEST CHART

```
procedure  Make_Value (Raw_Value: in  String;
                       Value: in  System.Address) is
--|*********************************************************************
--| Description:
--|    Make_value takes an enumeration character string and converts it
--|    into a binary bit string.  It does this by converting
--|   the address where the data areto be stored into a pointer
--|   to an enumeration and then uses text_io to get an enumeration out of
--|   a string and store it at the pointer.
--|
--| Parameter Description:
--|    raw_value   -> The character string to be converted.
--|    value   -> The address where the resulting bit string is to be
--|               stored.
--|
--| Notes:
--|    none
--|*********************************************************************
   Value_Location: Enum_Pointer := Address_To_Enum_Pointer(Value);
   End_Of_Value: Integer;
begin
      Internal_Io.Get (From => Raw_Value,
                       Item => Value_Location.all ,
                       Last => End_Of_Value);
exception
   when  Text_Io.Data_Error =>
      RAISE  Illegal_Value;
   when  others  =>
      RAISE ;
end  Make_Value;

end  Convert_Enumerations;
pragma  page;
```

```
--|*****************************************************************
--| Module Name:
--|    Types_Manager
--|
--| Module Type:
--|    Package Specification
--|
--| Module Purpose:
--|  This package is the interface to all the underlying type
--|  representations used by the application.
--|-----------------------------------------------------------------
--| Module Description:
--|  This package contains all the knowledge in the system about
--|  types.  It is both the database of legal (i.e., displayable)
--|  types and the mechanism by which data is converted from the
--|  internal RTM representation to a user-readable form.
--|
--| References:
--|    Design Documents:
--|      Real-Time Monitor Requirements
--|        Real-Time Monitor Design
--|
--|    User's Manual:
--|        RTM User's Manual
--|
--|    Testing and Validation:
--|        none
--|
--| Notes:
--|    none
--|-----------------------------------------------------------------
--| Modification History:
--|  22May87    rlvs    created
--|
--|-----------------------------------------------------------------
--| Distribution and Copyright Notice:
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--|
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--|     of Carnegie Mellon University, the U.S. Air Force,
--|     the Department of Defense, or the U.S. Government."
--|*****************************************************************
pragma page;
```

```
with System;
-- Use the type "address".
--

package Types_Manager is
--
-- Type identifier, used externally to refer to a named type.
--
   type Valid_Rtm_Type is private ;

   procedure Convert_Value_To_String (Data_Type: in Valid_Rtm_Type;
                                      Raw_Data: in System.Address;
                                      Number_Of_Characters: in Integer;
                                      The_Value: out String);
--|*********************************************************************
--| Description:
--|  This module converts from the internal representation used
--|  by the RTM in storing variable values into strings that
--|  are displayable to the user.
--|
--| Parameter Description:
--|  data_type   -> The Ada data type of raw data.
--|  raw_data    -> The address of the binary bit string to convert.
--|   number_of_characters -> The number of characters needed in the
--|                           value string.
--|   the_value  -> A string containing the displayable value.
--|*********************************************************************

   procedure Convert_String_To_Value (Data_Type: in Valid_Rtm_Type;
                                      Raw_Data: in System.Address;
                                      The_Value: in String);
--|*********************************************************************
--| Description:
--|  This module converts from the string entered by the user
--|  into the internal representation used by the RTM.
--|
--| Parameter Description:
--|  data_type   -> The Ada data type of raw data.
--|  raw_data    -> The address of the binary bit string to convert.
--|  the_value   -> The string whose value the user wishes deposited into
--|                 application memory.
--|*********************************************************************

   function Find (Name: in String) return Valid_Rtm_Type;
--|*********************************************************************
--| Description:
--|  This module is the lookup entry used to locate legal types
--|  It maps data obtained from the library_interface into types
--|  which the types_manager can convert.
--|
--| Parameter Description:
--|  name    -> The name of the Ada type associated with
--|             a variable.
--|  return  -> The internal identifier used to refer
--|             to the type.
```

```
--|*****************************************************************

   procedure Get_Type_Information (Type_Identifier: in Valid_Rtm_Type;
                                   Type_Length: out Integer;
                                   Indirection_Indicator: out Boolean);
--|*****************************************************************
--| Description:
--|  This module takes a type identifier and returns detailed
--|  information about the structure of the type to the caller.
--|
--| Parameter Description:
--|  type_indentifier   -> Identifier of the type about which
--|                        information is needed.
--|  type_length -> The size of the underlying type in the
--|                 size of the storage units used by the RTM
--|                 (i.e., smallest_units).
--|  indirection_indicator  -> Logical flag which when
--|                            true => an access type
--|                            false => any other type
--|*****************************************************************

--
--|*****************************************************************
--|
--|  Exceptions
--|
--|*****************************************************************
--
-- Exception used to signal a type that the types_manager is not
-- equiped to process.
   Type_Not_Found: exception ;
--
--  Exception used to signal illegal value string for type.
--
   Illegal_Value: exception ;
private

   type Valid_Rtm_Type is new Integer;

end Types_Manager;
pragma page;
```

```
--|*****************************************************************
--| Module Name:
--|    Types_Manager
--|
--| Module Type:
--|    Package Body
--|
--|-----------------------------------------------------------------
--| Module Description:
--|  This package embodies type database and the operations needed
--|  to access the database and convert data from bit strings into
--|  character strings.
--|
--|  The type database consists of an array of records (defined
--|  below), that contains all the data needed to convert a
--|  bit string into a value.  All data types accessible to the
--|  user must be defined in this database and have corresponding
--|  entries in the low-level conversion routines for their
--|  implementation.
--|
--| References:
--|    Design Documents:
--|      Real-Time Monitor Requirements
--|        Real-Time Monitor Design
--|
--|    User's Manual:
--|        RTM User's Manual
--|
--|    Testing and Validation:
--|        none
--|
--| Notes:
--|    none
--|-----------------------------------------------------------------
--| Modification History:
--|  04Jun87    rlvs    created
--|
--|-----------------------------------------------------------------
--| Distribution and Copyright Notice:
--|    TBD
--|
--| Disclaimer:
--|    "This work was sponsored by the Department of Defense.
--|     The  views  and conclusions contained in this document are
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--|     representing official policies,  either  expressed or implied,
--|     of Carnegie Mellon University, the U.S. Air Force,
--|     the Department of Defense, or the U.S. Government."
--|*****************************************************************
pragma page;
```

```
with Test_Stub;    ----------***** test only ******----------
-- Need access to the type definitions defined in the dummy application.
--

with Conversions;
-- Use the generic packages: "convert_floats", "convert_integers" and
-- "convert_enumerations".
-- Use the exception "illegal-value".
--
with Unchecked_Conversion;
-- Use service "unchecked_conversion".
--

package Types_Manager is
--
-- Define the names of all the legal types
--
   type Valid_Type_Name is (Integers, Floats, Rtm_Enum1, Rtm_Record);
--
-- Define all the data needed about each type:
--    type_name_as_string ->   A character string version of the type name.
--                This must match exactly with the type as it
--                exists in the application program, where the
--                type_name is a convenient enumeration literal
--                for this type.
--    type_name   -> An enumeration literal for the type.
--    type_length -> The size of the type in smallest_units.
--    display_width    -> Number of characters needed to display a value
--                of the type type_name.
--    indirection_level   -> An integer that indicates how many levels of
--                indirect access the type represents.
--
   type Type_Representation is record
      Type_Name_As_String: String(1..256);
      Type_Name: Valid_Type_Name;
      Type_Length: Integer := 0;
      Display_Width: Integer := 25;
      Indirection_Level: Integer := 0;
   end record ;
--
-- Define the table that holds all the type information; define
-- type_name_as_string in body.
--
   Number_Of_Valid_Types: Valid_Rtm_Type :=
      Valid_Type_Name'Pos(Valid_Type_Name'Last);
   Valid_Rtm_Types: array (0..Number_Of_Valid_Types) of Type_Representation :=
      ((Type_Name_As_String => (others => ' '),
        Type_Name => Integers, Type_Length => 1,
        Display_Width => 10,Indirection_Level => 0),
       (Type_Name_As_String => (others => ' '),
        Type_Name => Floats, Type_Length => 1,
        Display_Width => 10,Indirection_Level => 0),
       (Type_Name_As_String => (others => ' '),
        Type_Name => Rtm_Enum1, Type_Length => 1,
        Display_Width => 5,Indirection_Level => 0),
```

```
        (Type_Name_As_String => (others => ' '),
         Type_Name => Rtm_Record, Type_Length => 2,
         Display_Width => 20,Indirection_Level => 0));

   type Float_Pointer is access Float;
   function Address_To_Float_Pointer is new Unchecked_Conversion
     (Source => System.Address,
      Target => Float_Pointer);

   type Integer_Pointer is access Integer;
   function Address_To_Integer_Pointer is new Unchecked_Conversion
     (Source => System.Address,
      Target => Integer_Pointer);

   type Rtm_Enum_Pointer is access Test_Stub.Rtm_Enum;
   function Address_To_Rtm_Enum_Pointer is new Unchecked_Conversion
     (Source => System.Address,
      Target => Rtm_Enum_Pointer);

pragma page;
```

```
function Default_Float_Conversion (Raw_Value: in System.Address)
   return Float is
--|*****************************************************************
--| Description:
--|  Convert from a bit string at a system address to a floating
--|  point value.  This is valid for a one-CPU configuration
--|  only.
--|
--| Parameter Description:
--|  raw_value  ->  The address of the bit string to convert.
--|
--| Notes:
--|    none
--|*****************************************************************
   Value_Pointer: Float_Pointer;
   begin
      Value_Pointer := Address_To_Float_Pointer(Raw_Value);
      RETURN Value_Pointer.all ;
   end Default_Float_Conversion;
pragma Inline (Default_Float_Conversion);
--
-- Create the package to convert from bit strings to floats.
--

package Rtm_Reals is new Conversions.Convert_Floats
      (Width => 15,
       Source_Representation => Float,
       Target_Conversion => Default_Float_Conversion);


pragma page;
```

```
function Default_Integer_Conversion (Raw_Value: in System.Address)
   return Integer is
--|*****************************************************************
--| Description:
--|  Convert from a bit string at a system address to an integer
--|  value.  This is valid for a one-CPU configuration
--|  only.
--|
--| Parameter Description:
--|  raw_value  -> The address of the bit string to convert.
--|
--| Notes:
--|    none
--|*****************************************************************
   Value_Pointer: Integer_Pointer;
   begin
      Value_Pointer := Address_To_Integer_Pointer(Raw_Value);
      RETURN Value_Pointer.all ;
   end Default_Integer_Conversion;
pragma Inline (Default_Integer_Conversion);

--
-- Create the package to convert from bit strings to integers.
--

package Rtm_Integers is new Conversions.Convert_Integers
      (Width => 15,
       Source_Representation => Integer,
       Target_Conversion => Default_Integer_Conversion);

pragma page;
```

```
function Rtm_Enum_Conversion (Raw_Value: In System.Address)
  return Test_Stub.Rtm_Enum is
--|*********************************************************************
--| Description:
--|  Convert from a bit string at a system address to an
--|  enumeration value.  This is valid for a one-CPU configuration
--|  only.
--|
--| Parameter Description:
--|  raw_value  -> The address of the bit string to convert.
--|
--| Notes:
--|    none
--|*********************************************************************
  Value_Pointer: Rtm_Enum_Pointer;
  begin
    Value_Pointer := Address_To_Rtm_Enum_Pointer(Raw_Value);
    RETURN Value_Pointer.all ;
  end Rtm_Enum_Conversion;
pragma inline (Rtm_Enum_Conversion);
--
-- Create the package to convert from bit strings to rtm_enum enumerations.
--

package Rtm_Enums is new Conversions.Convert_Enumerations
     (Width => 5,
      Source_Representation => Test_Stub.Rtm_Enum,
      Target_Conversion => Rtm_Enum_Conversion);

pragma page;
```

```
--
-- Visible procedures
--
   procedure Convert_Value_To_String (Data_Type: in Valid_Rtm_Type;
                                      Raw_Data: in System.Address;
                                      Number_Of_Characters: in Integer;
                                      The_Value: out String) is separate ;

   procedure Convert_String_To_Value (Data_Type: in Valid_Rtm_Type;
                                      Raw_Data: in System.Address;
                                      The_Value: in String) is separate ;

   function Find (Name: in String) return Valid_Rtm_Type is separate ;

   procedure Get_Type_Information (Type_Identifier: in Valid_Rtm_Type;
                                   Type_Length: out Integer;
                                   Indirection_Indicator: out Boolean)
                                   is separate ;


--/*********************************************************************
--/
--/  Package Body
--/
--/  The body is responsible for initializing the string versions
--/  of all the type names.
--/
--/*********************************************************************

begin
   Valid_Rtm_Types(0).Type_Name_As_String(1..7)  := "integer";
   Valid_Rtm_Types(1).Type_Name_As_String(1..5)  := "float";
   Valid_Rtm_Types(2).Type_Name_As_String(1..9)  := "rtm_enum1";
   Valid_Rtm_Types(3).Type_Name_As_String(1..10) := "rtm_record";
end Types_Manager;
pragma page;
```

```
separate (Types_Manager)
procedure Convert_Value_To_String (Data_Type: in Valid_Rtm_Type;
                                   Raw_Data: in System.Address;
                                   Number_Of_Characters: in Integer;
                                   The_Value: out String) is
--|*****************************************************************
--| Description:
--|   This module converts from the internal representation used
--|   by the RTM in storing variable values into strings which
--|   are displayable to the user.  Since the bit pattern in the
--|   internal representation (collected by the Rtm_Core) may or
--|   may not have an analog in the machine running the user interface,
--|   a package of conversion routines is used to translate the bits into
--|   a form the host machine can handle.  This procedure then takes
--|   the bits and forms a user-readable string.
--|
--| Parameter Description:
--|     data_type   ->  The Ada data type of raw data.
--|     raw_data    ->  The address of the binary bit string to convert.
--|     number_of_characters -> The number of characters needed in the
--|                             value string.
--|     the_value   ->  A string containing the displayable value.
--|
--| Notes:
--|     none
--|*****************************************************************
begin
   The_Value := (The_Value'range => ' ');
   case Valid_Rtm_Types(Data_Type).Type_Name is
   when Integers =>
      Rtm_Integers.Make_String (Raw_Value => Raw_Data,
                                Field_Size => Number_Of_Characters,
                                Value => The_Value);
   when Floats =>
      Rtm_Reals.Make_String (Raw_Value => Raw_Data,
                             Field_Size => Number_Of_Characters,
                             Value => The_Value);
   when Rtm_Enum1 =>
      Rtm_Enums.Make_String  (Raw_Value => Raw_Data,
                              Field_Size => Number_Of_Characters,
                              Value => The_Value);
   when Rtm_Record =>
      null ;
   when others =>
      null ;
   end case ;
end Convert_Value_To_String;
pragma page;
```

```
separate (Types_Manager)
procedure Convert_String_To_Value (Data_Type: in Valid_Rtm_Type;
                                   Raw_Data: in System.Address;
                                   The_Value: in String) is
--|*****************************************************************
--| Description:
--|   This module converts from the string entered by the user
--|   into the internal representation used by the RTM.
--|   Since the bit pattern in the internal representation
--|   (collected by the Rtm_Core), may or may not have an analog
--|   in the machine running the user interface, a package of
--|   conversion routines is used to translate the bits into a
--|     form the target machine can handle.
--|
--| Parameter Description:
--|     data_type   -> The Ada data type of raw data.
--|     raw_data    -> The address of the binary bit string to convert.
--|   the_value   -> The string whose value the user wishes deposited into
--|                  application memory.
--|
--| Notes:
--|     none
--|*****************************************************************
begin
   case Valid_Rtm_Types(Data_Type).Type_Name is
   when Integers =>
      Rtm_Integers.Make_Value (The_Value,Raw_Data);
   when Floats =>
      Rtm_Reals.Make_Value (The_Value,Raw_Data);
   when Rtm_Enum1 =>
      Rtm_Enums.Make_Value (The_Value Raw_Data);
   when Rtm_Record =>
      null ;
   when others =>
      null ;
   end case ;
exception
   when Conversions.Illegal_Value =>
      RAISE Illegal_Value;
   when others =>
      RAISE ;
end Convert_String_To_Value;
pragma page;
```

```
with Case_Insensitive_String_Comparison;
-- Use service "equal".
--
separate (Types_Manager)
function Find (Name: in String) return Valid_Rtm_Type is
--|*************************************************************
--| Description:
--|   This module is the lookup entry used to locate legal types.
--|   It maps data obtained from the library_interface into types
--|   that the types_manager can convert.
--|
--| Parameter Description:
--|   name   -> The name of the Ada type associated with
--|             a variable.
--|   return -> The internal Identifier used to refer
--|             to the type.
--|
--| Notes:
--|   When a type is not found in the type database,
--|  the exception "type_not_found" is raised. Given that
--|  all this information is coming from the same source, this
--|  exception should never be used.
--|*************************************************************

package Cisc renames Case_Insensitive_String_Comparison;
  Type_Location: Valid_Rtm_Type;
  begin
--
-- Loop through the types in the database until we find the type or
-- run out of database.
--
    for Type_Location in 0..Number_Of_Valid_Types loop
      if Cisc.Equal (Name,
        Valid_Rtm_Types(Type_Location).Type_Name_As_String(Name'range ))
      then
        RETURN Type_Location;
      end if ;
    end loop ;
    RAISE Type_Not_Found;
end Find;
pragma page;
```

```
separate (Types_Manager)
procedure Get_Type_Information (Type_Identifier: in Valid_Rtm_Type;
                                Type_Length: out Integer;
                                Indirection_Indicator: out Boolean) is
--|*****************************************************************
--| Description:
--|  This module takes a type identifier and returns detailed
--|  information about the structure of the type to the caller.
--|
--| Parameter Description:
--|  type_indentifier   -> Identifier of the type about which
--|                        information is needed.
--|  type_length -> The size of the underlying type in the
--|                 size of the storage units used by the RTM
--|                 (i.e., smallest_units).
--|  indirection_indicator  -> Logical flag which when
--|                            true => an access type
--|                            false => any other type
--|*****************************************************************

begin
--
-- Extract the length (in smallest_units) of the type.
--
   Type_Length := Valid_Rtm_Types(Type_Identifier).Type_Length;
--
-- Determine if the type is an access pointer, based on its level
-- of indirection, i.e., 0 => no indirection.
--
   if Valid_Rtm_Types(Type_Identifier).Indirection_Level = 0 then
      Indirection_Indicator := False;
   else
      Indirection_Indicator := True;
   end if ;

end Get_Type_Information;
pragma page;
```

```
--|**********************************************************************
--| Module Name:
--|    Variable_Database
--|
--| Module Type:
--|    Package Specification
--|
--| Module Purpose:
--|  This module manages the interface to the underlying variable
--|  database.
--|----------------------------------------------------------------------
--| Module Description:
--|  This module manages the variable database created out of
--|  information obtained via the library_interface.
--|  The variable_database holds all the variables
--|  accessible to the user.  This package hides all
--|  details about the structure and manipulation of the
--|  variable database.  It also knows how to initialize the
--|  database at startup time.
--|
--|  This module manages the structure that is the variable_database;
--|  the actual data comes from the Library_Interface, which is
--|  responsible for the fidelity and content of the variable_database.
--|  The Variable_Database package has all the data we need
--|  about a variable (name, base_address, type_name, and type_identifier).
--|
--| References:
--|    Design Documents:
--|      Real-Time Monitor Requirements
--|      Real-Time Monitor Design
--|
--|    User's Manual:
--|      RTM User's Manual
--|
--|    Testing and Validation:
--|      none
--|
--| Notes:
--|    none
--|----------------------------------------------------------------------
--| Modification History:
--|  08Jul87    rlvs    created
--|
--|----------------------------------------------------------------------
--| Distribution and Copyright Notice:
--|    TBD
--|
--| Disclaimer:
--|    "This work was sponsored by the Department of Defense.
--|     The  views  and conclusions contained in this document are
--|     solely those of the author(s) and should not  be  interpreted  as
--|     representing official policies,  either  expressed or implied,
--|     of Carnegie Mellon University, the U.S. Air Force,
--|     the Department of Defense, or the U.S. Government."
--|**********************************************************************
```

pragma page;

```
with Library_Interface;
-- Use type "variable_representation".
--

package Variable_Database is

   type The_Variable is access Library_Interface.Variable_Representation;

   procedure Initialize_Database;
--|*********************************************************************
--| Description:
--|    This module is responsible for building the variable database
--|  by whatever means are available.
--|
--| Parameter Description:
--|    none
--|*********************************************************************

   function Find (Name: in String) return The_Variable;
--|*********************************************************************
--| Description:
--|    This function searches the variable database for the variable
--|  passed in.
--|
--| Parameter Description:
--|  name   -> The name of variable to look up.
--|
--| Notes:
--|    When a variable is not found in the variable database,
--|  the exception "variable_not_found" is raised.
--|*********************************************************************

--|*********************************************************************
--|
--|  The exception used to signal that a variable is not in
--|  the variable database, and thus not available to the user.
--|*********************************************************************
   Variable_Not_Found: exception ;

end Variable_Database;
pragma page;
```

```
--|*****************************************************************
--| Module Name:
--|    Variable_Database
--|
--| Module Type:
--|    Package Body
--|
--|-----------------------------------------------------------------
--| Module Description:
--|  This module encapsulates the actual structure of the variable
--|  database.  The database is stored as an ordered binary tree.
--|
--| References:
--|    Design Documents:
--|      Real-Time Monitor Requirements
--|        Real-Time Monitor Design
--|
--|    User's Manual:
--|        RTM User's Manual
--|
--|    Testing and Validation:
--|        none
--|
--| Notes:
--|    none
--|-----------------------------------------------------------------
--| Modification History:
--|  16Apr87    rlvs    created
--|
--|-----------------------------------------------------------------
--| Distribution and Copyright Notice:
--|    TBD
--|
--| Disclaimer:
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--|    representing official policies,  either  expressed or implied,
--|    of Carnegie Mellon University, the U.S. Air Force,
--|    the Department of Defense, or the U.S. Government."
--|*****************************************************************
pragma page;
```

```
with Case_Insensitive_String_Comparison;
-- Use the services "less" and "equal".
--
with Binarytrees;
-- Use generic package "binarytrees".
-- Use type "tree".
-- Use service "create".
--

package Variable_Database is
--
-- Set up a shorthand notation for the string package.
--

package Cisc renames Case_Insensitive_String_Comparison;

pragma page;
```

```
--
-- Internal procedures
--
--
-- Define the ordering function to be used by the tree package,
-- and create a package to manipulate trees of pointers.
--
   function  Ordering (Left: The_Variable;
                       Right: The_Variable) return  Boolean;

package Db is  new  Binarytrees (Itemtype => The_Variable,
                                 "<"      => Ordering);
--
-- Create the variable database.
--
   Variable_Database: Db.Tree := Db.Create;

   function  Ordering (Left: The_Variable;
                       Right: The_Variable) return  Boolean is
--|*****************************************************************
--| Description:
--|    This defines the ordering relation on the variable database.
--|  Since the elements in the tree are pointers, and we want the
--|  tree to be ordered alphabetically by variable name, we define
--|  the ordering function to use the pointers storedin the tree
--|  and access the name component of the record.
--|
--| Parameter Description:
--|  left    ->  left child of the parent node.
--|  right   ->  right child of the parent node.
--|  return  ->  true, if the left child's name is less than
--|                 the right child's name.
--|              false, otherwise.
--|
--| Notes:
--|    none
--|*****************************************************************
   begin
     RETURN  Cisc.Less (Left.Variable_Name,Right.Variable_Name);
   end ;
--
-- Visible procedures
--
   procedure  Initialize_Database is  separate ;


pragma  page;
```

```
    function Find (Name: in String) return The_Variable is
--/*****************************************************************
--/ Description:
--/   This function searches the variable database for the variable
--/  passed in.  It does this by making a tree iterator and walking
--/  the binary tree.  Since the tree is ordered, this amounts to a
--/  binary search of the tree.
--/
--/ Parameter Description:
--/  name   -> The name of variable to look up.
--/
--/ Notes:
--/   When a variable is not found in the variable database,
--/  the exception "variable_not_found" is raised.
--/*****************************************************************
     Database_Position: Db.Treeiter;
     Variable_Location: The_Variable;
  begin
--
-- We locate the variable of interest by iterating through all the
-- variables in the database until find it or run out of tree.
--
     Database_Position := Db.Maketreeiter(Variable_Database);
     while Db.More(Database_Position) loop
       Db.Next(Database_Position,Variable_Location);
       If Cisc.Equal(Variable_Location.Variable_Name(Name'range ),Name)
       then
         RETURN Variable_Location;
       end if ;
     end loop ;
     RAISE Variable_Not_Found;
end Find;

end Variable_Database;
pragma page;
```

```
with Unchecked_Deallocation;
-- Use the service "unchecked_deallocation".
--
with Types_Manager;
-- Use the service "find".
--
separate (Variable_Database)
procedure Initialize_Database is
--|*************************************************************
--| Description:
--|   This module is responsible for building the variable database
--|  by whatever means are available.
--|
--| Parameter Description:
--|   none
--|
--| Notes:
--|  All of the system-dependent issues related to obtaining
--|  object addresses have to be isolated in these packages:
--|    Library_interface: for static data information.
--|    Address_generator: for dynamic data information.
--|  These are the packages that must be changed to reflect the
--|  system configuration and environment.
--|*************************************************************
   procedure Free is new Unchecked_Deallocation
     (Library_Interface.Variable_Representation,The_Variable);

   Variable_Position: Library_Interface.Variable_Iterator;
   Node_Root: Db.Tree;
   Found_Variable: Boolean;
   The_Next_Variable: The_Variable;
begin
--
-- The basic operation is same for all the variables:
--   Build a variable_representation record.
--   Insert the record into the tree.
-- Repeat for all variables.
--
   Library_Interface.Make_Iterator(Variable_Position);
   while Library_Interface.More(Variable_Position) loop
   begin
     The_Next_Variable := new Library_Interface.Variable_Representation;
     Library_Interface.Get_Next
       (The_Iterator => Variable_Position,
        Variable_Information => The_Next_Variable.all );
     The_Next_Variable.Data_Type := Types_Manager.Find
       (Name => The_Next_Variable.Variable_Type);
     Db.Insertnode(N => The_Next_Variable,
                   T => Variable_Database,
                   Root => Node_Root,
                   Exists => Found_Variable);
   exception
     when Types_Manager.Type_Not_Found =>
       Free (The_Next_Variable);
   end ;
```

```
    end loop ;
end Initialize_Database;
pragma page;
```

```
--|**********************************************************
--| Module Name:
--|    Library_Interface
--|
--| Module Type:
--|    Package Specification
--|
--| Module Purpose:
--|    This module provides the interface needed by the RTM to build
--|  the variable database.
--|----------------------------------------------------------
--| Module Description:
--|    This package presumes an interface into a compiler library
--|  mechanism that is capable of generating an address for any
--|  statically allocated variable.  The interface is extremely
--|  simple; it consists of three parts:
--|
--|      make_iterator:  Initializes an iteration object and
--|                      allows the caller to step through the
--|                      library structure w/o regard to its
--|                      organization.
--|
--|      get_next:   Returns all the relevant information about
--|                  the next variable.
--|
--|      more:   Signals when the entire structure has been
--|              traversed, and there are no more variables.
--|
--| References:
--|    Design Documents:
--|      Real-Time Monitor Requirements
--|      Real-Time Monitor Design
--|
--|    User's Manual:
--|      RTM User's Manual
--|
--|    Testing and Validation:
--|      none
--|
--| Notes:
--|    none
--|----------------------------------------------------------
--| Modification History:
--|  02Jun87    rlvs    created
--|
--|----------------------------------------------------------
--| Distribution and Copyright Notice:
--|    TBD
--|
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```

```
--|     the Department of Defense, or the U.S. Government."
--|*****************************************************************
pragma page;
```

```
with Types_Manager;
-- Use type "type_identifier".
--

package Library_Interface is
--
-- The interation variable, used to control iteration.
--
   type Variable_Iterator is private ;
--
-- The information stored for a variable in the database is:
--    variable_name    -> Full Ada path name.
--    base_address -> Memory address of data (in application memory).
--    variable_type    -> The name of the type.
--    data_type  ->  The type identifier, used by the types_manager to
--                refer to a type.
--
   type Variable_Representation is record
      Variable_Name: String(1..100) := (others => ' ');
      Base_Address: Integer := 0;
      Variable_Type: String(1..100) := (others => ' ');
      Data_Type: Types_Manager.Valid_Rtm_Type;
   end record ;

pragma page;
```

```
   procedure Make_Iterator (The_Iterator: in out Variable_Iterator);
--|*****************************************************************
--| Description:
--|   Make_Iterator initializes an iteration parameter to the start of
--|   of the library structure; this parameter is then used to
--|   retrieve information from the structure.
--|
--| Parameter Description:
--|   the_iterator   -> The iteration parameter used by the
--|                     caller to access the next item.
--|*****************************************************************

   procedure Get_Next (The_Iterator: in out Variable_Iterator;
                       Variable_Information: out Variable_Representation);
--|*****************************************************************
--| Description:
--|     Get_Next takes an iteration parameter and returns all the
--|   relevant information about the vanable.
--|
--| Parameter Description:
--|   the_iterator   -> The iteration parameter used by the
--|                     caller to access the next item.
--|   return  -> All the available, relevant information about the variable.
--|*****************************************************************

   function More (The_Iterator: in Variable_Iterator) return Boolean;
--|*****************************************************************
--| Description:
--|     More takes an iteration parameter and determines if there are
--|   any additional variables yet to be processed.
--|
--| Parameter Description:
--|   the_iterator   -> The iteration parameter used by the
--|                     caller to access the next item.
--|     return       -> true   ==> there are more variables
--|                     false  ==> The entire structure has been traversed
--|*****************************************************************

private
   type Variable_Iterator is new Integer;

end Library_Interface;
pragma page;
```

```
--|*****************************************************************
--| Module Name:
--|    Library_interface
--|
--| Module Type:
--|    Package Body
--|
--|-----------------------------------------------------------------
--| Module Description:
--|    This package presumes an interface into a compiler library
--|  mechanism that is capable of generating an address for any
--|  statically allocated variable.  This interface is a dummy
--|  package that simply returns the addresses of the static
--|  data defined in the package test_stub.  It has to be replaced
--|  by whatever mechanism is available on the target machine.
--| -
--| References:
--|    Design Documents:
--|      Real-Time Monitor Requirements
--|       Real-Time Monitor Design
--|
--|    User's Manual:
--|       RTM User's Manual
--|
--|    Testing and Validation:
--|       none
--|
--| Notes:
--|    none
--|-----------------------------------------------------------------
--| Modification History:
--|  02Jun87    rlvs    created
--|
--|-----------------------------------------------------------------
--| Distribution and Copyright Notice:
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--|     of Carnegie Mellon University, the U.S. Air Force,
--|     the Department of Defense, or the U.S. Government."
--|*****************************************************************
pragma page;
```

```
with System;
-- Use type "address".
--
with Unchecked_Conversion;
-- Use service "unchecked_conversion".
--
with Test_Stub;
-- Use data objects defined here for testing the monitor.
--


package Library_Interface is
--
-- Used to convert all the system addresses into integers so that
-- they can be stored in the variable database.  In a system where
-- an address map is used, this routine will need to be reimplemented.
--
   function Get_Address is new Unchecked_Conversion
      (Source => System.Address,
       Target => Integer);

pragma page;
```

```
   procedure Make_Iterator (The_Iterator: in out Variable_Iterator) is
--/*********************************************************************
--| Description:
--|  Make_Iterator initializes an iteration parameter to the start
--|  of the library structure; this parameter is then used to
--|  retrieve information from the structure.
--|
--| Parameter Description:
--|  the_iterator   -> The iteration parameter used by the
--|                    caller to access the next item.
--|
--| Notes:
--|    none
--/*********************************************************************
   begin
      The_Iterator := 0;
   end Make_Iterator;

pragma page;
```

```
   procedure Get_Next (The_Iterator: in out Variable_Iterator;
                       Variable_Information: out Variable_Representation) is
--|*************************************************************
--| Description:
--|   Get_Next takes an iteration parameter and returns all the
--|  relevant information about the variable.
--|
--| Parameter Description:
--|  the_iterator   -> The iteration parameter used by the
--|                    caller to access the next item.
--|  return  -> All the available, relevant information about the variable.
--|
--| Notes:
--|   none
--|*************************************************************
   begin
      case The_Iterator is
      when 0 =>
         Variable_Information.Variable_Name(1..20) := "test_stub.my_integer";
         Variable_Information.Base_Address := Get_Address(Test_Stub.My_Integer'Address);
         Variable_Information.Variable_Type(1..7) := "integer";
      when 1 =>
         Variable_Information.Variable_Name(1..17) := "test_stub.my_real";
         Variable_Information.Base_Address := Get_Address(Test_Stub.My_Real'Address);
         Variable_Information.Variable_Type(1..5) := "float";
      when 2 =>
         Variable_Information.Variable_Name(1..17) := "test_stub.my_enum";
         Variable_Information.Base_Address := Get_Address(Test_Stub.My_Enum'Address);
         Variable_Information.Variable_Type(1..9) := "rtm_enum1";
      when 3 =>
         Variable_Information.Variable_Name(1..15) := "test_stub.int_2";
         Variable_Information.Base_Address := Get_Address(Test_Stub.Int_2'Address);
         Variable_Information.Variable_Type(1..7) := "integer";
      when 4 =>
         Variable_Information.Variable_Name(1..20) := "test_stub.my_pointer";
         Variable_Information.Base_Address := Get_Address(Test_Stub.My_Pointer'Address);
         Variable_Information.Variable_Type(1..10) := "rtm_record";
      when 5 =>
         Variable_Information.Variable_Name(1..22) := "test_stub.my_pointer.i";
         Variable_Information.Base_Address := Get_Address(Test_Stub.My_Pointer.I'Address);
         Variable_Information.Variable_Type(1..7) := "integer";
      when 6 =>
         Variable_Information.Variable_Name(1..22) := "test_stub.my_pointer.r";
         Variable_Information.Base_Address := Get_Address(Test_Stub.My_Pointer.R'Address);
         Variable_Information.Variable_Type(1..5) := "float";
      when 7 =>
         Variable_Information.Variable_Name(1..18) := "test_stub.my_array";
         Variable_Information.Base_Address := Get_Address(Test_Stub.My_Array'Address);
         Variable_Information.Variable_Type(1..8) := "array_10";
      when 8 =>
         Variable_Information.Variable_Name(1..21) := "test_stub.my_array(2)";
         Variable_Information.Base_Address := Get_Address(Test_Stub.My_Array(2)'Address);
         Variable_Information.Variable_Type(1..7) := "integer";
      when others =>
         null ;
```

```
        end case ;
        The_Iterator := The_Iterator + 1;
    end Get_Next;

pragma page;
```

```
  function More (The_Iterator: in Variable_Iterator) return Boolean is
--/*****************************************************************
--| Description:
--|    More takes an iteration parameter and determines if there are
--|  any additional variables yet to be processed.
--|
--| Parameter Description:
--|  the_iterator   -> The iteration parameter used by the
--|                    caller to access the next item.
--|    return       > true   ==> there are more variables
--|            false  ==> the entire structure has been traversed
--|
--| Notes:
--|    none
--|*****************************************************************
   begin
      if The_Iterator <= 8 then
         RETURN True;
      else
         RETURN False;
      end if ;
   end More;

end Library_Interface;
pragma page;
```

```
--|*****************************************************************
--| Module Name:
--|    Address_Generator
--|
--| Module Type:
--|    Package Specification
--|
--| Module Purpose:
--|  Defines the address abstraction used to refer to physical
--|  addresses in application memory and provides the interface
--|  needed to compute the address.
--|-----------------------------------------------------------------
--| Module Description:
--|  This module hides all the details surrounding the generation
--|  of object address by presenting one uniform interface to
--|  the rest of the RTM.
--|
--| References:
--|    Design Documents:
--|      Real-Time Monitor Requirements
--|      Real-Time Monitor Design
--|
--|    User's Manual:
--|      RTM User's Manual
--|
--|    Testing and Validation:
--|      none
--|
--| Notes:
--|    none
--|-----------------------------------------------------------------
--| Modification History:
--|  04Aug87    rlvs    created
--|
--|-----------------------------------------------------------------
--| Distribution and Copyright Notice:
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--|     the Department of Defense, or the U.S. Government."
--|*****************************************************************
pragma page;
```

```
with Variable_Database;


package Address_Generator is
--
-- Address abstraction:
--    base_address     -> Static base of the object.
--    address_offset   -> Offset from the base address of object
--              (for components of compound objects).
--    indirection ->   Boolean marker for identifying access type objects:
--              true   => access type
--              false  => any other (non-access) type
--
type Address_Representation is record
   Base_Address: Integer;
   Address_Offset: Integer;
   Indirection: Boolean;
end record ;
--
-- Default address
--
Null_Address: Address_Representation := (0,0,False);

function Compute_Address (Variable_Name: In String)
                  return Address_Representation;
--|*********************************************************************
--| Description:
--|    This module takes the database identifier of a variable and
--|  computes the address of the variable.
--|
--| Parameter Description:
--|  the_variable   -> Name of variable for which address is needed.
--|    return       -> Computed address of the variable.
--|*********************************************************************

end Address_Generator;
pragma page;
```

```
--|*****************************************************************
--| Module Name:
--|    Address_Generator
--|
--| Module Type:
--|    Package Body
--|
--|-----------------------------------------------------------------
--| Module Description:
--|   This module is responsible for implementing the address
--|   computation needed by the RTM.  Currently,  this is totally
--|   embodied by the Compute_Address procedure.
--|
--| References:
--|    Design Documents:
--|       Real-Time Monitor Requirements
--|         Real-Time Monitor Design
--|
--|    User's Manual:
--|         RTM User's Manual
--|
--|    Testing and Validation:
--|         none
--|
--| Notes:
--|    none
--|-----------------------------------------------------------------
--| Modification History:
--|    08Aug87        rlvs     created
--|
--|-----------------------------------------------------------------
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--|     of Carnegie Mellon University, the U.S. Air Force,
--|     the Department of Defense, or the U.S. Government."
--|*****************************************************************

with Types_Manager;
-- Use the service "find".
--

package Address_Generator is

function  Compute_Address (Variable_Name: in String)
                  return  Address_Representation is separate ;

end Address_Generator;
pragma page;
```

```
separate (Address_Generator)
function Compute_Address (Variable_Name: in String)
                  return Address_Representation is
--/*****************************************************************
--/ Description:
--/   This module takes the database identifier of a variable and
--/  computes the address of the variable.
--/
--/ Parameter Description:
--/  the_variable   -> Name of variable for which address is needed.
--/    return       -> Computed address of the variable.
--/
--/ Notes:
--/  No address offset is computed since all accessible variables are
--/  in the database and the base_address already has the offset
--/  taken into account.
--/*****************************************************************
   The_Variable: Variable_Database.The_Variable;
   Address: Address_Generator.Address_Representation := Null_Address;
   Address_Offset: constant Integer := 0;
   Data_Length: Integer;
   Access_Flag: Boolean;
begin
   The_Variable := Variable_Database.Find(Variable_Name);
   Types_Manager.Get_Type_Information (The_Variable.Data_Type,
                              Data_Length,
                              Access_Flag);
   Address := (The_Variable.Base_Address,
          Address_Offset,
          Access_Flag);
   RETURN Address;
exception
  when Variable_Database.Variable_Not_Found =>
    RAISE ;
  when Types_Manager.Type_Not_Found =>
    RAISE ;
  when others =>
    null ;
end Compute_Address;
pragma page;
```

```
--|*****************************************************************
--| Module Name:
--|   Dialogue_manager
--|
--| Module Type:
--|   Package Specification
--|
--| Module Purpose:
--|  This package manages the interface to the application.  It
--|  does this by hiding all details about retrieving variable information
--|  from the application.
--|-----------------------------------------------------------------
--| Module Description:
--|  The Dialogue_Manager manages the interface to the application in
--|  a number of ways:
--|     1. It knows how to talk to the Rtm_Core, which is the
--|        RTM's interface to the application.
--|     2. It knows how to convert data retrieved from the Rtm_Core
--|        into strings which the user can understand.
--|
--| References:
--|   Design Documents:
--|     Real-Time Monitor Requirements
--|       Real-Time Monitor Design
--|
--|   User's Manual:
--|       RTM User's Manual
--|
--|   Testing and Validation:
--|       none
--|
--| Notes:
--|  none
--|
--|-----------------------------------------------------------------
--| Modification History:
--|  20Apr87    rlvs       created
--|
--|-----------------------------------------------------------------
--| Distribution and Copyright Notice:
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--|    of Carnegie Mellon University, the U.S. Air Force,
--|    the Department of Defense, or the U.S. Government."
--|*****************************************************************
pragma page;
```

```
with Calendar; use Calendar;
-- The "time" and "duration" types are used.


package Dialogue_Manager is

-- Internal (RTM) representation of a variable.
   type Variable_Identifier is private ;

-- All value functions return items of this type.
   subtype Value_String is String(1..80);

-- The direction flag, informs the Dialogue_Manager about the direction of
-- access on a variable:
--    read => Get the data from the application.
--    write => Put the data in the application.
   type Io_Usage is (Read,Write);

pragma page;
```

```
   function  Get_Value (Vid: in  Variable_Identifier;
                        Number_Of_Characters: in  Integer := 80)
                        return  Value_String;
--|*****************************************************************
--| Description:
--|  Converts the current value of a variable (denoted as a
--|  variable identifier) into a character string containing
--|  the requested number of characters.  Since this operation
--|  requires a variable_identifier, it can only be performed on an
--|  active variable.  This function returns
--|  a string appropriate to the type of the variable.
--|
--| Parameter Description:
--|    vid ->       The identifier of the variable whose value is needed
--|          (obtained from get_identifier above).
--|  number_of_characters -> The number of characters needed in the
--|                          value string.
--|    return       -> A string containing a displayable value.  For a
--|             composite structure, the individual components
--|             are delimited by the separator selected.
--|*****************************************************************

pragma  page;
```

```
   function Get_Time_Of_Value (Vid: in Variable_Identifier)
                    return Value_String;
--|*****************************************************************
--| Description:
--|  Convert the time associated with a variable value (i.e., the
--|  collection time) into a displayable string.  Since this operation
--|  requires a variable_identifier, it can only be performed on an
--|  active variable.
--|
--| Parameter Description:
--|    vid ->       The identifier of the variable whose time is needed
--|          (obtained from get_identifier above).
--|    return       -> The collection time of the current value as a
--|             displayable string.
--|*****************************************************************

pragma page;
```

```
   procedure Set_Value (Vid: In  Variable_Identifier;
                        Value: In  Value_String);
--|*****************************************************************
--| Description:
--|  Sets the value of the selected variable, normally in preparation for
--|  a set (write) operation.  Since this operation requires a
--|  variable_identifier, it can only be performed on an active
--|  variable.
--|
--| Parameter Description:
--|    vid ->       The identifier of the variable whose value is being set
--|          (obtained from get_identifier above).
--|    value -> A string containing the value to deposit into
--|             the variable internal representaion.  For composite
--|             structure, the separator selected.
--|*****************************************************************

pragma page;
```

```
   function  Activate (Name: in  String;
                       Rate: in  Duration;
                       Starting_Time: Time;
                       Usage: in  Io_Usage) return  Variable_Identifier;
--|*************************************************************
--| Description:
--|  This entry activates variables for data collection or modification.
--|  It keeps track of which variables in the variable database are of
--|  interest to the user.
--|
--| Parameter Description:
--|   vid ->       The identifier of the variable to activate
--|          (obtained from get_identifier above).
--|  rate    -> The repetition rate at which the variable is to
--|             be accessed:
--|                a value of 0 ==> a one-time access
--|                a value > 0 ==> read the value every rate seconds
--|  starting_time  -> The time of day the start command was processed.
--|  usage  -> Direction of access on the variable.
--|*************************************************************

pragma  page;
```

```
   procedure Deactivate (Vid: in Variable_Identifier;
                         Usage: in Io_Usage);
--|*****************************************************************
--| Description:
--|  Informs the dialogue_manager that the variable is no longer
--|  of interest and data collection is not needed.
--|
--| Parameter Description:
--|   vid ->      The identifier of the variable to deactivate
--|         (obtained from get_identifier above).
--|  usage  -> Direction of access on the variable being deactivated
--|           (since it is possible for a variable to activate in
--|           both directions).
--|*****************************************************************

pragma page;
```

```
--/**************************************************************
--/
--/ Exceptions rasied and propagated
--/
--/**************************************************************
-- Issued when a request is made for a variable that is not available
-- to the user through the RTM.
   Variable_Not_Found: exception ;
--
-- Issued when a request is made to deposit the value of a variable, but the
-- value is not appropriate for the type of the variable.
   Illegal_Value: exception ;

private

   type Active_List_Representation (Length_Of_Value: Positive);

   type Variable_Identifier is access Active_List_Representation;

end Dialogue_Manager;
pragma page;
```

```
--|*****************************************************************
--| Module Name:
--|   Dialogue_Manager
--|
--| Module Type:
--|   Package Body
--|
--|-----------------------------------------------------------------
--| Module Description:
--|  The dialogue_manager is responsible for the interface to the
--|  application, and as such, it needs to know a great deal more
--|  about the Ada variables than the user does.  To do this work,
--|  the dialogue_manager is divided into three parts:
--|
--|     I. The dialogue_manager, which  is the interface
--|  -     to all the services performed:
--|            getting identifiers
--|            activating variables
--|            retrieving values
--|
--|     II. Collect_data package, that knows how to collect
--|         the data from the core and how to convert data into
--|         strings which represent a displayable value.
--|         This is a highly volatile package, which must have
--|         a conversion routine available for every possible
--|         Ada type which will be monitored.
--|
--| References:
--|   Design Documents:
--|     Real-Time Monitor Requirements
--|       Real-Time Monitor Design
--|
--|   User's Manual:
--|       RTM User's Manual
--|
--|   Testing and Validation:
--|       none
--|
--| Notes:
--|  none
--|
--|-----------------------------------------------------------------
--| Modification History:
--|  30Apr87    rlvs       created
--|
--|-----------------------------------------------------------------
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--|    of Carnegie Mellon University, the U.S. Air Force,
```

```
--|     the Department of Defense, or the U.S. Government."
--|*****************************************************************
pragma page;
```

```
with Address_Generator;
-- Use the type "address_representation".
--
with Variable_Database;
-- Use the type "the_variable".
-- Use the services "find" and "intialize_database".
--
with Types_Manager;
-- Use the services "convert_value_to_string", "convert_string_to_value",
-- and "get_type_information".
--
with Lists;
-- This is a generic linked list package which is instantiated and used to
-- manipulate list objects.
--
with Sysgen;
-- Need access to the sysgen parameters that control the interface to the
-- Rtm_Core.
--

package Dialogue_Manager is
-- This package encapsulates the task runs asynchronously from the rest
-- of the monitor, collecting data from the application, and depositing
-- data into the application. The main reason for the package around the
-- task is to compensate for a VAX/VMS problem with elaborating subroutines
-- local to the body of a task at run time.
--

package Collect_Data is
   procedure From_Application;
--tbd   task from_application is
--tbd    entry initiate;
--tbd    entry get_next_set;
--tbd   end from_application;
end Collect_Data;
--
--
--
   type Value_Representation is array (Positive range <>) of
     Sysgen.Smallest_Unit;
--
-- While the variable_database contains information about all the
-- variables in the system, the RTM is only concerned with a subset of these
-- variables at any one time. To keep track of the variables currently
-- relevant to the RTM, we introduced the concept of active variables.
-- The discussion below describes the implementation of active variables.
--
-- Active_list_representation defines the data needed to periodically
-- access a single variable in the application:
--    database_identifier -> Pointer to the variable's data in the
--                  variable database.
--     object_address     -> Address of the variable/object at the time of
--                activation.
--    update_rate -> The rate at which the variable is to be read.
--    next_scheduled_reading   -> The time of the next reading of the
```

```
--                    variable out of application memory.
--    value    -> The current value of the variable, as read from
--        application memory or set by the user.
--    time_tag   ->   Time associated with the current value.
--
   type Active_List_Representation (Length_Of_Value: Positive) is record
      Database_Identifier: Variable_Database.The_Variable;
      Object_Address: Address_Generator.Address_Representation;
      Update_Rate: Duration;
      Next_Scheduled_Reading: Time;
      Value: Value_Representation (1..Length_Of_Value) :=
        (1..Length_Of_Value => 0);
--    time_tag: time;
   end record ;
--
-- Since we are almost always going to be working with several variables
-- at a time, we organize all the active variables into a linked list.
-- To do this, we must define an equality operator for list
-- items and instatiate a generic list package with the item representation
-- and the equality definition (defined further below).  Now, we have a
-- linked list of pointers to the active variable representations.
--
   function  Equality (Left: Variable_Identifier;
                       Right: Variable_Identifier) return  Boolean;

package Active_Lists is new  Lists (Itemtype => Variable_Identifier,
                                    Equal => Equality);
--
-- Once we have the list manipulator in place, we define two lists of
-- active vanables:
--    active_read_list -> Holds all the varaiables currently
--              being read by the RTM.
--    active_write_list  ->   Holds all the variables currently
--                being written by the RTM.
   Active_Read_List: Active_Lists.List := Active_Lists.Create;
   Active_Write_List: Active_Lists.List := Active_Lists.Create;


package Collect_Data is separate ;

pragma  page;
```

```
   function  Equality (Left: Variable_Identifier;
                       Right: Variable_Identifier) return  Boolean is
--|*****************************************************************
--| Description:
--|    This function defines the meaning of equality on the items
--|  of type active_list_representation.  We needed to define this
--|  since normal equality would have compared two access values for
--|  numeric equality (which would not have worked).  The meaning
--|  of equality of two entries in the active list is:
--|     compare the value of the pointers in the active list,
--|        if they match ==> the two items are pointing at the
--|                          same variable and are therefore
--|                          equal.
--|
--| Parameter Description:
--|    left  -> pointer to an active_list_representation record
--|    right -> pointer to an active_list_representation record
--|    return       -> boolean,
--|      true    -> if the pointer component of both records point at
--|                 the same item
--|      false   -> if they point at different items
--|
--| Notes:
--|    none
--|*****************************************************************
      begin
        RETURN  Left = Right;
      end ;


pragma  page;
```

```
  function Get_Value (Vid: In Variable_Identifier;
                      Number_Of_Characters: In Integer := 80)
                      return Value_String is
--|*****************************************************************
--| Description:
--|   Converts the current value of a variable (denoted as a
--|   variable identifier) into a character string containing
--|   the requested number of characters.  This function returns
--|   a string appropriate to the type of the variable.
--|
--| Parameter Description:
--|   vid -> The identifier of the variable whose value is needed
--|          (obtained from get_identifier above).
--|   number_of_characters -> The number of characters needed in the
--|                           value string.
--|   return -> A string containing a displayable value.  For a
--|             composite structure, the individual components
--|             are delimited by the separator selected.
--| Notes:
--|   none
--|*****************************************************************
    Value: Value_String;
    begin
      Collect_Data.From_Application;
      Types_Manager.Convert_Value_To_String(Vid.Database_Identifier.Data_Type,
                                            Vid.Value(1)'Address,
                                            Number_Of_Characters,
                                            Value);
      RETURN Value;
    end Get_Value;

pragma page;
```

```
   function Get_Time_Of_Value (Vid: in Variable_Identifier)
                        return Value_String is
--|*****************************************************************
--| Description:
--|    Convert the time associated with a variable value (i.e., the
--|    collection time) into a displayable string.
--|
--| Parameter Description:
--|    vid -> The identifier of the variable whose time is needed
--|           (obtained from get_identifier above).
--|    return -> The collection time of the current value as a
--|              displayable string.
--|
--| Notes:
--|    none
--|*****************************************************************
   begin
      RETURN "";
   end Get_Time_Of_Value;

pragma page;
```

```
   procedure Set_Value (Vid: in Variable_Identifier;
                        Value: in Value_String) is
--|*************************************************************
--| Description:
--|    Sets the value of the selected variable, normally in preparation
--|    for a set (write) operation.  The types_manager converts
--|  the string entered by the user into internal representation.
--|
--| Parameter Description:
--|    vid -> The identifier of the variable whose value is being set
--|           (obtained from get_identifier above).
--|    value  -> A string containing the value to deposit into
--|              the variable internal representaion.  For composite
--|              structure, the separator selected.
--|
--| Notes:
--|    none
--|*************************************************************
      New_Value: Value_Representation(1..Vid.Length_Of_Value);
      begin
         Types_Manager.Convert_String_To_Value(Vid.Database_Identifier.Data_Type,
                                               New_Value'Address,
                                               Value);
         Vid.Value := New_Value;
      exception
         when Types_Manager.Illegal_Value =>
            RAISE Illegal_Value;
         when others =>
            RAISE ;
      end Set_Value;

   pragma page;
```

```
   function Activate (Name: in String;
                      Rate: in Duration;
                      Starting_Time: Time;
                      Usage: in Io_Usage) return Variable_Identifier is
--|*************************************************************
--| Description:
--|   This entry activates variables for data collection or modification.
--|   It builds the active variable representations used by
--| the collect_data package in gathering information from the
--| application. Basically, all the data needed to access
--| a variable are passed in as parameters. Activate builds a
--| record from the data and adds it to the current list of active
--| variables.
--|
--| Parameter Description:
--|   name -> The name of the variable to activate.
--|   rate  -> The repetition rate at which the variable is
--|          to be accessed:
--|             a value of 0 ==> a one-time access
--|             a value > 0 ==> read the value every rate seconds
--|   starting_time  -> The time of day the start command was processed.
--|   usage  -> Direction of access on the variable.
--|   return      -> The identifier of the variable to be activated.
--|
--| Notes:
--|   Activate operates on both the read and write lists.
--|
--|   Currently, the RTM is not sophisticated enough to understand
--| the complexites of offsets as encountered in arrays, for example.
--| Thus, the offset is always returned as a 0. This means that each
--| element of an array must explicitly have an entry in the variable
--| database. This is solely a restriction on the prototype RTM, not
--| a restriction on the concepts involved.
--|*************************************************************
   Data_Length: Integer;
   Vid: Variable_Identifier;
   Access_Flag: Boolean;
   Active_Variable: Variable_Database.The_Variable;
   Address: Address_Generator.Address_Representation;
   begin
--
-- Determine the system address for the variable/object.
--
      Active_Variable := Variable_Database.Find(Name);
      Types_Manager.Get_Type_Information (Active_Variable.Data_Type,
                                          Data_Length,
                                          Access_Flag);
      Address := Address_Generator.Compute_Address(Variable_Name => Name);
--
-- Build the  activation record for the variable.
--
      Vid := new Active_List_Representation(Data_Length);
      Vid.Object_Address := Address;
      Vid.Database_Identifier := Active_Variable;
      Vid.Update_Rate := Rate;
```

```
      Vid.Next_Scheduled_Reading := Starting_Time+Rate;

      case Usage is
--
-- Insert the activation record into the proper list.
--
      when Read =>
        Active_Lists.Attach (Active_Read_List,Vid);
      when Write =>
        Active_Lists.Attach (Active_Write_List,Vid);
      end case ;
--
      RETURN Vid;
    exception
      when Variable_Database.Variable_Not_Found =>
        RAISE Variable_Not_Found;
      when others =>
        RAISE ;
    end Activate;

pragma page;
```

```
   procedure Deactivate (Vid: In Variable_Identifier,
                         Usage: In Io_Usage) Is
--|*****************************************************************
--| Description:
--|    Takes the identifier (and list) of an active variable and
--|  deletes it from the active variable list.  This operation
--|  destroys the entry in the list, but doesn't affect the data
--|  about the variable anywhere else.
--|
--| Parameter Description:
--|    vid -> The identifier of the variable to deactivate
--|           (obtained from get_identifier above).
--|    usage  -> direction of access on the variable being deactivated
--|              (since it is possible for a variable to activate in
--|              both directions).
--|
--| Notes:
--|    none
--|*****************************************************************
   begin
      case Usage is
        when Read =>
          Active_Lists.Deleteitem(Active_Read_List,Vid);
        when Write =>
          Active_Lists.Deleteitem(Active_Write_List,Vid);
      end case ;
   end Deactivate;

--|*****************************************************************
--|
--|  Dialogue_manager package body
--|
--| The body has one startup operation:
--|  Initialize the variable database.
--|*****************************************************************
begin
   Variable_Database.Initialize_Database;
--tbd   collect_data.form_application.inititate;
end Dialogue_Manager;
pragma page;
```

```
--/*****************************************************************
--| Module Name:
--|    Collect_Data
--|
--| Module Type:
--|    Package Body
--|
--|---------------------------------------------------------------
--| Module Description:
--|  This package implements the functions which interface to the
--|  RTM_core and do the actual data collection.
--|
--|
--| References:
--|    Design Documents:
--|       RTM Design Description
--|      RTM Design
--|
--|    User's Manual:
--|       RTM User's Manual
--|
--|    Testing and Validation:
--|       none
--|
--| Notes:
--|    none
--|---------------------------------------------------------------
--| Modification History:
--|  22May87    rlvs    created
--|
--|---------------------------------------------------------------
--| Distribution and Copyright Notice:
--|    TBD
--|
--| Disclaimer:
--|    "This work was sponsored by the Department of Defense.
--|     The  views  and conclusions contained in this document are
--|     solely those of the author(s) and should not  be  interpreted  as
--|     representing official policies,  either  expressed or implied,
--|     of Carnegie Mellon University, the U.S. Air Force,
--|     the Department of Defense, or the U.S. Government."
--|*****************************************************************
pragma page;
```

```
with Rtm_Core;
-- Use the type "rtm_core_command_representation".
--
with Calendar;
-- Use the type "time".
--
separate (Dialogue_Manager)

package Collect_Data is
--
-- This structure allows us map the data returned by the RTM_core
-- back into the variable database. It consists of:
--    vid ->   The pointer into the variable database where the
--      variable's value is kept.
--
   Result_Map: array (2..Sysgen.Core_Buffer_Size) of Variable_Identifier;
--
-- These structures map from the data_types of variables into the Rtm_Core
-- commands needed to access the type.
--
   type Core_Operation_Representation is (Deposit, Extract);
   type Command_Map_Representation is array
      (Core_Operation_Representation) of
       Rtm_Core.Rtm_Core_Command_Representation;
   Command_Map: Command_Map_Representation :=
      (Deposit => Rtm_Core.Deposit,
       Extract => Rtm_Core.Extract );
--
--
--
   Next_Update_Time: Calendar.Time;
--
-- Internal procedures
--
procedure Build_Rtm_Core_Commands (
   List: in out Active_Lists.List;
   Command: in Core_Operation_Representation;
   Command_Position: in out Rtm_Core.Buffer_Range;
   Data_Position: in out Rtm_Core.Buffer_Range) is separate ;

   procedure Retrieve_Rtm_Core_Results (Ending_Position: in Integer) is
      separate ;
--
-- Package procedures
--
   procedure From_Application is separate ;

end Collect_Data;
pragma page;
```

```
with Rtm_Core;
-- Use the service "process_buffer".
--
separate (Dialogue_Manager.Collect_Data)
procedure From_Application is
--tbd Task body from_application is
--|*************************************************************
--| Description:
--|    This procedure mechanizes the actual reading and writing of
--|  data in application memory. It does this by:
--|      1. Building a list with all the deposit (Set) commands to be done.
--|      2. Adding to that list all the extract (Read or Start) commands
--|         to be done.
--|      3. Calling the RTM_Core to process the commands and waiting
--|         for it to complete.
--|      4. Retrieving the results of the commands and storing
--|         them in the variable database.
--|
--| Parameter Description:
--|  none
--|
--| Notes:
--|*************************************************************
   Next_Command_Position: Rtm_Core.Buffer_Range := 1;
   Next_Data_Position: Rtm_Core.Buffer_Range := 1;
begin
--tbd   Accept initiate;
--tbd   next_update_time := calendar.clock + sysgen.minimum_delay;
--tbd   loop
--tbd delay next_update_time - calendar.clock;
--tbd Accept get_next_set do
      if Calendar.Clock < Next_Update_Time then
         RETURN ;
      end if ;
      Build_Rtm_Core_Commands
         (List => Active_Write_List,
          Command => Deposit,
          Command_Position => Next_Command_Position,
          Data_Position => Next_Data_Position);
      Build_Rtm_Core_Commands
         (List => Active_Read_List,
          Command => Extract,
          Command_Position => Next_Command_Position,
          Data_Position => Next_Data_Position);
      Rtm_Core.Process_Buffer;
      Retrieve_Rtm_Core_Results (Ending_Position => Next_Command_Position);
--tbd end get_next_set;
--tbd   End loop;
end From_Application;
pragma page;
```

```
separate (Dialogue_Manager.Collect_Data)
procedure Build_Rtm_Core_Commands (
   List: in out Active_Lists.List;
   Command: in Core_Operation_Representation;
   Command_Position: in out Rtm_Core.Buffer_Range;
   Data_Position: in out Rtm_Core.Buffer_Range) is
--|*****************************************************************
--| Description:
--|    This module takes a list of active variables and a command
--|  to be associated with those variables and builds a command
--|  buffer for the Rtm_Core to process.  It does this by:
--|      1. Looping through all the variables in the active list.
--|      2. Checking the next operation time of each variable,
--|         and if the time has come:
--|           a. for each piece of the variables value,
--|              - format the command triplet:
--|                 (command, address, value/status)
--|              - format the map entry to retrieve the data with
--|
--| Parameter Description:
--|   list ->       The active variable list from which the
--|          commands are to be formatted.
--|   command       -> The Rtm_Core command to be formatted.
--|   command_position   -> The beginning point in the
--|                         command buffer where the commands
--|                         are to be placed.
--|   data_position   ->   The beginning point in the
--|                         data buffer where the data are (to be)
--|                         stored.
--|
--| Notes:
--|   command_postion & data_position must be intialized and
--|   passed into this procedure to insure proper functioning.
--|   Once passed in, these parameters are modified and returned so
--|   that successive calls to this procedure can incrementally build
--|   the command buffer.
--|*****************************************************************
   List_Position: Active_Lists.Listiter;
   The_Next_Variable: Variable_Identifier;
   List_Size: Integer;
   Data_Count: Positive;
begin
--
-- We operate on this list in a slightly different way.  We get
-- the size of the list before we begin operating on the list, and we
-- build a list iterator to get elements from the list.  Then, we loop
-- the list checking time of each entry.  If the scheduled time has arrived,
-- we format the command and move the entry to the end of the list, the
-- reason being that we can only fit a finite number of commands in the
-- buffer at any one time; this movement insures that commands missed on
-- one pass will be picked up on a subsequent pass.
--
   List_Size := Active_Lists.Length(List);
   List_Position := Active_Lists.Makelistiter(List),
```

```
   for Count in 1..List_Size loop

      Active_Lists.Next(List_Position,The_Next_Variable);
      Data_Count := The_Next_Variable.Length_Of_Value;

      if (Calendar.Clock >= The_Next_Variable.Next_Scheduled_Reading) and
        (Data_Position + Data_Count <= Sysgen.Core_Buffer_Size) then
--
-- Build the next command for the core.
--
         Command_Position := Command_Position + 1;
         Rtm_Core.Command_Buffer(Command_Position).Command :=
           Command_Map (Command);
         Rtm_Core.Command_Buffer(Command_Position).Data_Address :=
           The_Next_Variable.Object_Address;
         Rtm_Core.Command_Buffer(Command_Position).Data_Count :=
           Data_Count;
         Rtm_Core.Command_Buffer(Command_Position).Data_Location :=
           Data_Position;
--
-- Build the map to extract the results later.
--
         Result_Map(Command_Position) := The_Next_Variable;
--
-- Fill in the data to transfer to the application (for deposit commands).
--
         case Command is
         when Deposit =>
           for Next in 1..Data_Count loop
             Rtm_Core.Data_Buffer(Data_Position) :=
               The_Next_Variable.Value(Next);
             Data_Position := Data_Position + 1;
           end loop ;
         when Extract =>
           Data_Position := Data_Position + Data_Count;
         end case ;
--
-- Mark the command buffer as ready for processing.
--
         Rtm_Core.Command_Buffer(1).Command := Rtm_Core.Buffer_Available;
--
-- Move the element just processed to the end of the list.
--
         Active_Lists.Deleteitem (L => List,
                                  Element => The_Next_Variable);
         The_Next_Variable.Next_Scheduled_Reading :=
           The_Next_Variable.Next_Scheduled_Reading +
           The_Next_Variable.Update_Rate;
         Active_Lists.Attach (List,The_Next_Variable);
       end if ;
--
-- Finally, keep a running tab on the next scheduled update time for all
-- the variables.  This will prevent us from doing any unneeded
-- list traversals.
--
```

```
      if Next_Update_Time > The_Next_Variable.Next_Scheduled_Reading then
        Next_Update_Time := The_Next_Variable.Next_Scheduled_Reading;
      end if;
    end loop;
end Build_Rtm_Core_Commands;
pragma page;
```

```
separate (Dialogue_Manager.Collect_Data)
procedure Retrieve_Rtm_Core_Results (Ending_Position: in Integer) is
--|*************************************************************
--| Description:
--|    This procedure maps the data collected by the Rtm_Core
--|  back into the active variable list.
--|
--| Parameter Description:
--|  ending_position -> Marks the position of the last command
--|                    stored in the command buffer.
--|
--| Notes:
--|    none
--|*************************************************************
   Next_Data_Location: Rtm_Core.Buffer_Range := 1;
begin
--
-- Loop through all the commands in the core buffer, mapping
-- the data back into the active variable list.
--
   for Position in 2..Ending_Position loop
      for Next in 1..Rtm_Core.Command_Buffer(Position).Data_Count loop
         Result_Map(Position).Value(Next) :=
            Rtm_Core.Data_Buffer(Next_Data_Location);
         Next_Data_Location := Next_Data_Location + 1;
      end loop ;
   end loop ;
end Retrieve_Rtm_Core_Results;
pragma page;
```

```
--|*****************************************************************
--| Module Name:
--|    Sysgen
--|
--| Module Type:
--|    Package Specification
--|
--| Module Purpose:
--|    Define the system-wide constants needed when rehosting and
--|  tuning the RTM.
--|-----------------------------------------------------------------
--| Module Description:
--|    This package defines the system-dependent constants needed
--|  by the RTM.  All the constants are completely described below.
--|
--| References:
--|  -  Design Documents:
--|        RTM Design Description
--|
--|    User's Manual:
--|        none
--|
--|    Testing and Validation:
--|        none
--|
--| Notes:
--|    none
--|-----------------------------------------------------------------
--| Modification History:
--|  02Apr87    rlvs    Created
--|
--|-----------------------------------------------------------------
--| Distribution and Copyright Notice:
--|    TBD
--|
--| Disclaimer:
--|    "This work was sponsored by the Department of Defense.
--|     The  views  and conclusions contained in this document are
--|     solely those of the author(s) and should not  be  interpreted  as
--|     representing official policies,  either  expressed or implied,
--|     of Carnegie Mellon University, the U.S. Air Force,
--|     the Department of Defense, or the U.S. Government."
--|*****************************************************************
pragma page;
```

```
package Sysgen is
--
-- Defines the minimum amount of time between successive updates of the
-- screen.
--
   Minimum_Delay: constant  Duration := 0.1;
--
-- Defines the  smallest addressable unit on the RTM_core CPU.
--
   subtype  Smallest_Unit is  Integer;
--
-- Defines the maximum number of commands which the RTM_core can
-- process in one time-slice.
--
   Core_Buffer_Size: constant  := 1000;
--
-- Defines the number of processors in the RTM/application configuration.
--
   Processor_Count: constant  := 1;
--
-- Defines the default disk where the RTM can access stored information.
--
   Default_Rtm_Device: constant  String := "ps:[rtm.prototype.rtm]";

end  Sysgen;
pragma  page;
```

```
--|**********************************************************
--| Module Name:
--|    Rtm_Core
--|
--| Module Type:
--|    Package Specification
--|
--| Module Purpose:
--|  Performs read (extract) and write (deposit) operations on
--|  system storage units, which are the smallest addressable
--|  units in the system.
--|----------------------------------------------------------
--| Module Description:
--|    This package is an abstraction  for the actual application
--|  software underlying the RTM.  This allows the RTM to know how
--|  to talk with the Rtm_Core, but relieves it of the need to
--|  know anything about the specific application.
--|
--| References:
--|    Design Documents:
--|      Real-Time Monitor Requirements
--|        Real-Time Monitor Design
--|
--|    User's Manual:
--|        RTM User's Manual
--|
--|    Testing and Validation:
--|        none
--|
--| Notes:
--|  There are two buffers that form the interface between the RTM
--|  and the application:  the command_buffer, shown below, which holds
--|  all the command and address information needed to perform the
--|  requested operations and the data_buffer, which simply holds the
--|  data to deposit or the data extracted.  These two buffers are
--|  connected by the <data_location> field shown below.
--|
--|          Command Buffer
--|          ---------------------------------------
--|          |     <buffer available>              |
--|          ---------------------------------------
--|          |     <deposit marker>                |
--|          ---------------------------------------
--|          | <address> {base address,offset,flag} |
--|          ---------------------------------------
--|          |      <data count>                   |
--|          ---------------------------------------
--|          |      <data location>                |
--|          ---------------------------------------
--|          |          .                          |
--|          |          .                          |
--|          |          .                          |
--|          ---------------------------------------
--|          |     <extract marker>                |
--|          ---------------------------------------
```

```
--|        | <address> {base address,offset,flag} |
--|        ----------------------------------------
--|        |      <data count>                    |
--|        ----------------------------------------
--|        |      <data location>                 |
--|        ----------------------------------------
--|        |          .                           |
--|        |          .                           |
--|        |          .                           |
--|        ----------------------------------------
--|        |     <end of buffer marker>           |
--|        ----------------------------------------
--|
--|
--|  This function is the partition point of the monitor in
--|  a multi-processor implementation.  The core function
--|  described here is all of the monitor that MUST be part
--|  of the application timing and control.
--|
--|  The size of the command and data buffers is a sysgen parameter
--|  which can be tuned to meet the performance needs of the system.
--|
--|  The details on how the partition between one and two processors
--|  would take place are discussed in the design description
--|  document for the RTM.
--|-------------------------------------------------------------------
--| Modification History:
--|  02Apr87    rlvs    Created
--|
--|-------------------------------------------------------------------
--| Distribution and Copyright Notice:
--|    TBD
--|
--| Disclaimer:
--|    "This work was sponsored by the Department of Defense.
--|     The  views  and conclusions contained in this document are
--|     solely those of the author(s) and should not  be  interpreted  as
--|     representing official policies,  either  expressed or implied,
--|     of Carnegie Mellon University, the U.S. Air Force,
--|     the Department of Defense, or the U.S. Government."
--|*******************************************************************
pragma page;
```

```
with Address_Generator;
-- Uses the type "address_representation".
--
with Sysgen;
--
-- Uses "core_buffer_size", which is the system parameter that controls
-- the maximum size of the interface buffer to the core and thereby controls
-- the maximum amount of processing the core will need.
-- Uses "smallest_unit", which defines the smallest addressable unit that
-- can be read or written.
--

package Rtm_Core is
--
-- Define the legal commands which will be recognized;
-- these are defined as an integer subtype because in a two-CPU
-- configuration, there is knowledge on either CPU about the
-- representataion of data on the other CPU. Therefore, integers are
-- the safest means of communicating commands across a bus.
--
   subtype Rtm_Core_Command_Representation is Positive range 1..10;
   Address_Error:   constant Rtm_Core_Command_Representation := 10;
   Buffer_Available: constant Rtm_Core_Command_Representation := 9;
   Results_Available: constant Rtm_Core_Command_Representation := 8;
   Masked_Deposit:constant Rtm_Core_Command_Representation := 7;
   Masked_Extract: constant Rtm_Core_Command_Representation := 6;
   Deposit:        constant Rtm_Core_Command_Representation := 3;
   Extract:        constant Rtm_Core_Command_Representation := 2;
   End_Of_Buffer:  constant Rtm_Core_Command_Representation := 1;
--
-- This object makes two arrays visible to the external world,
-- the reason being that in a single processor system, the object commanding
-- the Rtm_Core can do so by simply filling in the buffers before invoking it.
-- In a multi-processor environment, the buffers are visible to
-- the bus I/O handler. The command_buffer is filled with as many
-- deposit/extract commands as will fit. The only requirements on the
-- buffer are that it start with a buffer_available command and that the
-- last command be followed by an end_of_buffer command. Also,
-- no usable data in the data_buffer are sent back to the RTM,
-- until the buffer_available command has been overwritten by a
-- results_available command in the command_buffer.
--
   subtype Buffer_Range is Integer range 1..Sysgen.Core_Buffer_Size;
   type Buffer_Entry_Representation is record
      Command: Rtm_Core_Command_Representation := End_Of_Buffer;
      Data_Address: Address_Generator.Address_Representation;
      Data_Count: Buffer_Range;
      Data_Location: Buffer_Range;
   end record ;
   Command_Buffer: array (1..Buffer_Range'Last) of
      Buffer_Entry_Representation := (others =>
         (End_Of_Buffer,Address_Generator.Null_Address,1,1));
   Data_Buffer: array (1..Buffer_Range'Last) of
      Sysgen.Smallest_Unit := (others => 0);
```

pragma page;

```
   procedure Process_Buffer;
--|*****************************************************************
--| Description:
--|   Instructs the core to check its communications buffer for commands.
--|   If there are commands available, then process the buffer.  If not,
--|   no processing action is taken.
--|
--| Parameter Description:
--|     none
--|*****************************************************************

end Rtm_Core;
pragma page;
```

```
--|*****************************************************************
--| Module Name:
--|    RTM_Core
--|
--| Module Type:
--|    Package Body
--|
--|-----------------------------------------------------------------
--| Module Description:
--|   This module processes the commands formatted by the RTM,
--|   by converting integers from the command buffer into pointers
--|   and then using the pointers to access the data.
--|
--| References:
--|    Design Documents:
--|      Real-Time Monitor Requirements
--|        Real-Time Monitor Design
--|
--|    User's Manual:
--|        RTM User's Manual
--|
--|    Testing and Validation:
--|        none
--|
--| Notes:
--|    none
--|-----------------------------------------------------------------
--| Modification History:
--|   16Apr87    rlvs    created
--|
--|-----------------------------------------------------------------
--| Distribution and Copyright Notice:
--|    TBD
--|
--| Disclaimer:
--|    "This work was sponsored by the Department of Defense.
--|     The  views  and conclusions contained in this document are
--|     solely those of the author(s) and should not  be  interpreted  as
--|     representing official policies,  either  expressed or implied,
--|     of Carnegie Mellon University, the U.S. Air Force,
--|     the Department of Defense, or the U.S. Government."
--|*****************************************************************
pragma page;
```

```
with System;
-- Need access to the type "address".
--
with Unchecked_Conversion;
-- Need "unchecked_conversion" to convert the integer in the
-- command buffer into a pointer to a value of type "sysgen.smallest_unit".
--

package Rtm_Core is
--
-- Set up the system work needed to access data on the core CPU.
-- First, we create a type that points to a value of the smallest
-- addressable unit on the CPU.  Then, we instantiate unchecked_conversion
-- to allow us to transform the integer form of the address in the command
-- buffer into an address that Ada will understand.
--
   type Value_Pointer is access Sysgen.Smallest_Unit;
   function Get_Address is new Unchecked_Conversion
      (Source => Integer,
       Target => Value_Pointer);
   function Get_Actual_Address is new Unchecked_Conversion
      (Source => Sysgen.Smallest_Unit,
       Target => Value_Pointer);

pragma page;
```

```
--
-- Internal procedures
--
   procedure Compute_Address (Data_Address: out Integer;
                              Command_Number: in Integer) is
--|*****************************************************************
--| Description:
--|   This module is responsible for decoding the address parameter
--|   of the command passed in.  This is a two-step operation:
--|
--|      1. For indirect addresses, the actual base address
--|         must be read.
--|      2. The offset must be added to the base address.
--|
--|
--| Parameter Description:
--|   data_address    -> The computed address of the desired data.
--|   command_number  -> Command being processed in the command_buffer.
--|
--| Notes:
--|    none
--|*****************************************************************
      Address: Address_Generator.Address_Representation
        renames Command_Buffer(Command_Number).Data_Address;
      Value_Address: Value_Pointer;
      Actual_Base_Address: Integer;
   begin
      if Address.Indirection then
         Value_Address := Get_Address(Address.Base_Address);
         Actual_Base_Address := Integer(Value_Address.all );
         Data_Address := Actual_Base_Address + Address.Address_Offset;
      else
         Data_Address := Address.Base_Address + Address.Address_Offset;
      end if ;
   end Compute_Address;

pragma page;
```

```
   procedure Deposit_Data (Data_Address: in Integer;
                           Command_Number: in Buffer_Range) is
--|*************************************************************
--| Description:
--|  Moves the data from the data_buffer passed by the RTM into
--|  application memory.
--|
--| Parameter Description:
--|  data_address   -> The computed address of the desired data.
--|                    In the case of a mulitple unit read, this
--|                    is the address of the first unit in the block.
--|  command_number -> Command being processed in the command_buffer.
--|
--| Notes:
--|   none
--|*************************************************************
   Next_Address: Integer := Data_Address;
   The_Value: Value_Pointer := Get_Address(Next_Address);
   Data_Offset: Buffer_Range renames Command_Buffer(Command_Number).Data_Location;
   begin
      for Next in 0..Command_Buffer(Command_Number).Data_Count-1 loop
         The_Value.all := Data_Buffer(Next + Data_Offset);
         Next_Address := Next_Address + 1;
         The_Value := Get_Address(Next_Address);
      end loop ;
   end Deposit_Data;

pragma page;
```

```
   procedure Extract_Data (Data_Address: in Integer;
                           Command_Number: in Buffer_Range) is
--|*************************************************************
--| Description:
--|   Moves the data from application memory into data_buffer passed
--|   back to the RTM.
--|
--| Parameter Description:
--|   data_address   -> The computed address of the desired data.
--|                     In the case of a mulitple unit read, this
--|                     is the address of the first unit in the block.
--|   command_number -> Command being processed in the command_buffer.
--|
--| Notes:
--|     none
--|*************************************************************
      Next_Address: Integer := Data_Address;
      The_Value: Value_Pointer := Get_Address(Next_Address);
      Data_Offset: Buffer_Range renames Command_Buffer(Command_Number).Data_Location;
      begin
        for Next in 0..Command_Buffer(Command_Number).Data_Count-1 loop
          Data_Buffer(Next + Data_Offset) := The_Value.all ;
          Next_Address := Next_Address + 1;
          The_Value := Get_Address(Next_Address);
        end loop ;
      end Extract_Data;

pragma page;
```

```
   procedure Get_Buffer is
--|*****************************************************************
--| Description:
--|    This procedure is available for a two-CPU implementation
--|  of the RTM.  It is responsible for knowing how to receive
--|  data over a communications bus and doing any conversions needed
--|  to get the data into a usable format.
--|
--| Parameter Description:
--|    none
--|
--| Notes:
--|    none
--|*****************************************************************
   begin
      case Sysgen.Processor_Count is
      when 1 =>
         null ;
      when 2 =>
--
--    Here is where the bus i/o goes
--
         null ;
      when others =>
         null ;
      end case ;
   end Get_Buffer;

pragma page;
```

```
   procedure Send_Buffer is
--/*****************************************************************
--/ Description:
--/    This procedure is available for a two-CPU implementation
--/  of the RTM.  It is responsible for knowing how to send
--/  data over a communications bus and doing any conversions needed
--/  to get the data into a usable format before transmission.
--/
--/ Parameter Description:
--/    none
--/
--/ Notes:
--/    none
--/*****************************************************************
   begin
      case Sysgen.Processor_Count is
      when 1 =>
        null ;
      when 2 =>
--
--     Here is where the bus i/o goes
--
        null ;
      when others =>
        null ;
      end case ;
   end Send_Buffer;


pragma page;
```

```
   procedure Process_Buffer is
--/*****************************************************************
--| Description:
--|  This module reads the command buffer from the interface
--|  (which doesn't exist on a one-CPU implementation) and loops
--|  through the commands performing the operations.  Currently there
--|  are four operations defined:
--|     masked_deposit  ->  Requests that the core move a value
--|                         from the command buffer into application
--|                         memory, but mask the target so that unaffected
--|                         bits will be preserved (for rep clauses).
--|     masked_extract ->   Requests that the core move a value
--|                         from application memory into the command
--|                         buffer, but mask the target so that unaffected
--|                         bits will be preserved (for rep clauses).
--|     deposit  -> Requests that the core move a value
--|                 from the command buffer into application memory.
--|     extract ->  Requests that the core move a value
--|                 from application memory into the command buffer.
--|  When all the commands in the buffer have been processed, the
--|  buffer_available command of the RTM is overwritten by the
--|  results_available command of the core.
--|
--| Parameter Description:
--|    none
--|
--| Notes:
--|  If the core is unable to use an address contained in the
--|  command buffer, the command associated with that address
--|  is overwritten by an address_error command.
--|
--|  The masked_extract and masked_deposit operations are not currently
--|  implemented.
--|*****************************************************************
   Value_Address: Integer;

   begin
--
-- Load the buffer, and check to see if any new commands are
-- available for processing.  If not, we simply cut out without
-- further ado.
--
      Get_Buffer;
      if (Command_Buffer(1).Command /= Buffer_Available) then
         return ;
      end if ;
--
-- When there are commands to be processed, we loop through the command
-- buffer, processing commands until an end_of_buffer is found, or
-- we reach the end of the buffer
--
      for Command in 2..Sysgen.Core_Buffer_Size loop
         case Command_Buffer(Command).Command is
            when Deposit =>
               Compute_Address (Value_Address, Command);
```

```
            Deposit_Data (Value_Address, Command);
          when Extract =>
            Compute_Address (Value_Address, Command);
            Extract_Data (Value_Address, Command);
          when Masked_Extract =>
            null ;
          when End_Of_Buffer =>
            EXIT ;
          when others =>
            null ;
        end case ;
      end loop ;
--
-- Mark the results as being available and return them to the RTM
--
      Command_Buffer(1).Command := Results_Available;
      Send_Buffer;
    end Process_Buffer;

end Rtm_Core;
```

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UNLIMITED, UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

ADA191095

REPORT DOCUMENTATION PAGE

1a REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b RESTRICTIVE MARKINGS NONE
2a SECURITY CLASSIFICATION AUTHORITY N/A	3 DISTRIBUTION/AVAILABILITY OF REPORT APPROVED FOR PUBLIC RELEASE DISTRIBUTION UNLIMITED
2b DECLASSIFICATION/DOWNGRADING SCHEDULE N/A	
4 PERFORMING ORGANIZATION REPORT NUMBER(S) CMU/SEI-87-TR-39	5 MONITORING ORGANIZATION REPORT NUMBER(S) ESD-TR-87-202
6a NAME OF PERFORMING ORGANIZATION SOFTWARE ENGINEERING INSTITUTE 6b OFFICE SYMBOL (If applicable) SEI	7a NAME OF MONITORING ORGANIZATION SEI JOINT PROGRAM OFFICE
6c ADDRESS (City, State and ZIP Code) CARNEGIE MELLON UNIVERSITY PITTSBURGH, PA 15213	7b ADDRESS (City, State and ZIP Code) ESD/XRSI HANSCOM AIR FORCE BASE, MA 01731
8a NAME OF FUNDING/SPONSORING ORGANIZATION SEI JOINT PROGRAM OFFICE 8b OFFICE SYMBOL (If applicable) SEI JPO	9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER F1962885C0003
8c ADDRESS (City, State and ZIP Code) CARNEGIE MELLON UNIVERSITY SOFTWARE ENGINEERING INSTITUTE JPO PITTSBURGH, PA 15213	10 SOURCE OF FUNDING NOS PROGRAM ELEMENT NO: PROJECT NO: N/A TASK NO: N/A WORK UNIT NO: N/A
11 TITLE (Include Security Classification) PROTOTYPE REAL-TIME MONITOR: ADA CODE	
12 PERSONAL AUTHOR(S) ROGER VAN SCOY	
13a TYPE OF REPORT FINAL 13b TIME COVERED FROM _____ TO _____	14 DATE OF REPORT (Yr., Mo., Day) NOVEMBER 1987 15 PAGE COUNT 182
16 SUPPLEMENTARY NOTATION	
17 COSATI CODES FIELD / GROUP / SUB GR.	18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number) ADA, REAL-TIME MONITOR, OBJECT-ORIENTED

19 ABSTRACT (Continue on reverse if necessary and identify by block number)

THIS REPORT IS THE CODE THAT IMPLEMENTS THE PROTOTYPE REAL-TIME MONITOR (RTM). IN ADDITION, THE DOCUMENTATION IN THE PACKAGE SPECIFICATIONS AND BODIES FORMS THE IMPLEMENTATION DESCRIPTION OF THE RTM.

20 DISTRIBUTION/AVAILABILITY OF ABSTRACT UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT ☐ DTIC USERS ☒	21 ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED, UNLIMITED
22a NAME OF RESPONSIBLE INDIVIDUAL KARL SHINGLER	22b TELEPHONE NUMBER (Include Area Code) (412) 268-7630 22c OFFICE SYMBOL SEI JPO

DD FORM 1473, 83 APR EDITION OF 1 JAN 73 IS OBSOLETE

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